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Stimulation of Sterigmatocystis by chloroform

MARION ELIZABETH LATHAM

The response of fungi to the influence of salts and other chemical compounds, as manifested by accelerated growth, increased weight, and active evolution of carbon dioxide, has been the subject of several investigations within a recent period. Raulin's * early observations have been much extended by Richards † who has ascribed ‡ the action to a more economical use of the nutrition at hand, that is, he has proved the economic coefficient of Kunstmann § to decrease as the stimulant approaches its point of optimum efficacy. Ono, ‖ Yashuda,¶ Hattori, ** Stevens,†† Iwanoff,‡‡ Benecke§§ and others have extended the range of

* Raulin, J. Études chimiques sur la vegetation. Ann. Sc. Nat. Bot. V. **11**: 93. 1869.

† Richards, H. M. Die Beeinflussung des Wachsthums einiger Pilze durch chemische Reize. Jahrb. Wiss. Bot. **30**: 665. 1897.

‡ Richards, H. M. The effect of chemical irritation on the economic coefficient of sugar. Bull. Torrey Club **26**: 463. 1899.

§ Kunstmann, H. Ueber das Verhältniss z. Pilzernte u. verbrauchter Nährung. Inaug. Dissert. Leipzig, 1895.

‖ Ono, N. Ueber die Wachsthumsbeschleunigung einiger Algen u. Pilze. Jour. Coll. Sci. Imp. Univ. Tokyo **13**: 141. 1900.

¶ Yashuda, A. On the effect of alkaloids upon some moulds. Bot. Mag. Tokyo **15**. 1901.

** Hattori, H. Studien über die Einwirkung der Kupfersulfats auf einige Pflanzen. Jour. Coll. Sci. Imp. Tokyo **15**: 371. 1901.

†† Stevens, F. L. The effect of aqueous solutions upon the germination of fungus spores. Bot. Gaz. **26**: 377. 1898.

‡‡ Iwanoff, K. S. Ueber die Wirkung einiger Metallsalze und einatomiger Alkohole auf die Entwickelung von Schimmelpilzen. Bot. Centralb. **98**: 97. 1905.

§§ Benecke, W. Die zur Ernährung der Schimmelpilze nothwendigen Metalle. Jahrb. Wiss. Bot. **28**: 487. 1895; and Einige neuere Untersuchungen über den Einfluss von Mineralsalzen auf Organismen. Bot. Zeit. **62²**: 113. 1904.

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toxic compounds, all with concordant results; namely, that those substances which in larger amounts are fatal, serve to stimulate the organism to increase in activity when present in sufficiently small quantities, in accordance with the generalization of Hueppe.* In addition, Ono † has found that the waste through oxalic acid formation is at the same time lessened; and Watterson ‡ that although there is greater expiration of CO_2 the increase is only parallel with that of the crop and its production relatively normal. Schulz § working with yeast; Hueppe,‖ Effront, ¶ and Lindet ** with bacteria; and Ono †† and Livingston ‡‡ with algae have reached like conclusions as far as growth is concerned.

Copeland and Kahlenberg,‖‖ and Kahlenberg and True,*** and more lately Kanda,††† working with higher plants tell of stimulation caused by salts. Similarly Copeland ‡‡‡ has obtained increased CO_2 evolution from work with phanerogams and tadpoles, interpretating the apparent vigor, however, as an evidence of harm rather than benefit.

Townsend §§§ mixed ether with water supplied to seeds and thus hastened germination. He has also shown that seeds, subjected to HCN gas ‖‖‖ for a short time, sprout sooner and grow

* Hueppe, F. The Principles of Bacteriology, 89, 90. Trans. by E. O. Jordan.

† *L. c.*

‡ Watterson, A. The effect of chemical irritation on the respiration of fungi. Bull. Torrey Club **31**: 291. 1904.

§ Schulz. Ueber Hefegifte. Bot. Zeit. **46**: 610. 1888.

‖ *L. c.*

¶ Effront. Compt. rend. **119**: 169. 1894.

** Lindet. Compt. rend. **138**: 508. 1904.

†† *L. c.*

‡‡ Livingston, B. E. Chemical stimulation of a green alga. Bull. Torrey Club **32**: 1. 1905.

‖‖ Copeland, E. B. & Kahlenberg, L. The influence of the presence of pure metals upon plants. Trans. Wis. Acad. **12**: 454. 1899.

*** Kahlenberg, L. & True, R. H. On the toxic action of dissolved salts. Bot. Gaz. **22**: 81. 1896.

††† Kanda, M. Reizwirkung einiger Metallsalze auf das Wachsthum höherere Pflanzen. Jour. Coll. Sci. Imp. Tokyo **19**: 1. 1904.

‡‡‡ Copeland, E. B. Chemical stimulation and the evolution of CO_2. Bot. Gaz. **35**: 81. 1903.

§§§ Townsend, C. O. The effect of hydrocyanic acid gas upon grains and other seeds. Bot. Gaz. **31**: 241. 1901.

‖‖‖ Townsend, C. O. The correlation of growth under the influence of injuries. Ann. Bot. **11**: 509. 1897.

more rapidly than those not so treated; that *Avena* seedlings grown in a sufficiently weak atmosphere of ether are at first retarded and then accelerated, finally returning to their normal rate of growth if the shock be not too long continued; and that in small amounts ether vapor will aid germination in the spores of *Penicillium* and *Mucor*,* although larger doses are inimical. Duggar † says that a saturated atmosphere of chloroform is fatal to the spores of *Aspergillus flavus* and *Phycomyces* and without benefit to *Sterigmatocystis*, and that ether is of no consequence as a stimulant in germinating *Aspergillus*. With *Aspergillus* (*Sterigmatocystis*) *niger*, Kosinski ‡ finds respiration retarded when exposed to ether fumes.

Ewart,§ working with chloroform in the water of water plants noted suspension of CO_2 assimilation agreeing with the earlier results of Claude Bernard. Kegel,‖ however, finds with *Elodea canadensis* an increment of CO_2 assimilation in some percentages of ether and chloroform, but a sudden check in the case of a lesser amount. On the other hand, Bonnier and Mangin ¶ were able, by adding ether carefully, to stop assimilation of CO_2 without affecting respiration, an observation in accordance with that of Schwarz,** who, with both ether and chloroform, has recorded stoppage of oxygen evolution not accompanied by elimination of CO_2 evolution until the plant was fatally affected. Ewart's †† results with mosses were similar. Movement in the protoplasm of *Philotria* (*Elodea*),

* Townsend, C. O. Effect of ether upon the germination of seeds and spores. Bot. Gaz. 27: 458. 1899.

† Duggar, B. M. Physiological studies with reference to the germination of certain fungous spores. Bot. Gaz. 31: 38. 1901.

‡ Kosinski, I. Die Athmung bei Hungerzuständen u. unter Einwirkung von mechanischen u. chemischen Reizmitteln bei Aspergillus niger. Jahrb. Wiss. Bot. 37: 137. 1902.

§ Ewart, A. J. Action of chloroform on CO_2 assimilation. Ann. Bot. 12: 415. 1898.

‖ Kegel, W. Ueber den Einfluss von Chloroform und Aether auf die Assimilation von Elodea canadensis. Inaug. Dissert. Göttingen, 1905.

¶ Bonnier, G. & Mangin, L. Recherches sur l' action chlorophyllienne séparée de la respiration. Ann. Sci. Nat. VII. 3: 5. 1886.

** Schwarz, F. Zur Kritik der Methode des Gasblasenzählens an submersen Wasserpflanzen. Untersuch. Bot. Inst. zu Tübingen, 1: 97. 1881.

†† Ewart, A. J. On assimilatory inhibition in chlorophyllous plants. Jour. Linn. Soc. 31: 364. 1896.

as seen by Farmer and Waller,* ceased under the influence of ether and chloroform, the latter proving more powerful.

With various seedlings in an ether atmosphere, Morkowine † obtained increase of respiration in the light; Bonnier and Mangin ‡ got no such effect in the dark. Puriewitsch, as quoted by Morkowine,§ concluded that in ether vapor, transformation of sugar to starch is inhibited. Jumelle ‖ believes transpiration increased in light and decreased in dark by ether, Zaleski ¶ that proteid formation is hindered by the same substance. Pfeffer ** cites Elfving †† and Laurén ‡‡ as authorities for the observation that CO_2 formation, but not growth, is augmented in higher plants by a not too long exposure to chloroform; and finally, Johanssen §§ has proved the economic value of ether in forcing early blooming in flowering plants. The period of winter rest is shortened, rapidity of growth and total evolution of CO_2 increased.

The majority of the investigations with chloroform and ether, it will be noted, have had to do with their effect on green plants. Townsend ‖‖ and Duggar ¶¶ to be sure, experimented with fungus spores but their work stopped with germination; and Kosinski *** was concerned only with the respiration factor. It has been the aim of the piece of work here described to compare the effect of chloroform vapor on fungus growth, as shown by increase in dry substance, with the results quoted above. Therefore *Sterigmatocystis nigra* (*Aspergillus niger*) in the main and *Penicillium glaucum*

* Farmer, J. B. & Waller, A. D. Observations on the action of anaesthetics on vegetable and animal protoplasm. Proc. Royal Soc. **63**: 213. 1898.

† Morkowine, N. Recherches sur l' influence des anesthésiques sur la respiration des plantes. Rev. Gen. de Bot. **11**: 289. 1899.

‡ Bonnier & Mangin, *l. c.*

§ *L. c.*

‖ Jumelle, H. Influence des anesthésiques sur la transpiration des végétaux. Rev. Gen. de Bot. **2**: 417. 1890.

¶ Zaleski, W. Zur Aetherwirkung auf die Stoffumwandlung in den Pflanzen. Ber. Deuts. Bot. Gesells. **18**: 292. 1900.

** Pfeffer. Physiology of Plants, **1**: 564. Trans. by Ewart.

†† Elfving. Ueber die Einwirkung von Aether u. Chloroform auf die Pflanzen. Oefversigt af Finska Vetensk. Soc. Forh. **28**: 36. 1886.

‡‡ Laurén. Bot. Jahresb. **20**[1]: 92. 1892.

§§ Johanssen, W. L. Das Aether-Verfahren beim Frühtreiben. Jena. 1900.

‖‖ Bot. Gaz. *l. c.*

¶¶ *L. c.*

*** *L. c.*

to a lesser extent were grown on the nutrient solutions prescribed by Pfeffer * and designated as A and C in the first paper on the subject by Richards,† the cultures confined in an atmosphere of chloroform of known or approximately known value and the effect upon dry weight of the crop, economic coefficient and acid coefficient noted.

The work was done in the botanical laboratory of Barnard College during the years 1904 and 1905 under the guidance of Dr. Herbert Maule Richards, to whom his student is much indebted for his kindness and interest. To the New York Botanical Garden many thanks are due for extending the privileges of the library.

To grow the fungi, small dishes 70 mm. in diameter and 30 mm. deep were used. These, in all series following IV, were of the non-sol glass of Whitall, Tatum & Co. Each culture dish rested on two strips of glass over a half Petri dish containing 40 c.c. of a 10 per cent. KOH solution. The Petri dish in turn sat upon a ground-glass plate. On glass strips laid across the culture dish was supported a small watch glass to receive the chloroform. In operating, each dish was arranged as described and all covered by a bell-jar which was ground down on to the glass plate in a glycerine-gelatine seal. After the seal had hardened, amounts of chloroform calculated to the capacity of the jars — due allowance having been made for the solids and liquids within — were run in through the neck which was at once closed with a rubber stopper. It is possible in this way to regulate the supply of chloroform vapor with tolerable accuracy, for the placing of the stopper in position occupies but a moment and relatively little of the chloroform can volatilize and escape. Moreover, the seal at the base of the jar is sufficiently strong to be proof against any small pressure generated by the vaporizing liquid.

In manipulation, the usual precautions were observed. The culture dishes, before each using, were soaked in dichromate cleaning solution, washed, rinsed in distilled and redistilled water and sterilized in hot air at 100°–120° C. The bell-jars were

* Pfeffer, W. Ueber Election organischer Nährstoffe. Jahrb. Wiss. Bot. **28**: 205. 1895.

† *L. c.*

rinsed in formalin; the glass strips and watch glasses were washed and sterilized in hot air (100°–120° C.). All flasks and pipettes were handled similarly.

The redistilled water mentioned above was the distilled water furnished for ordinary laboratory purposes in the college — the still is tin-lined — redistilled and condensed through a block-tin tube. A considerable portion passing over at first was discarded and the operation stopped while a quantity remained in the distilling flask. This water was used in making all solutions, as well as for the final rinsings of the apparatus. Its specific conductivity as determined in the physics laboratory varied between 2.74×10^{-6} and 1.59×10^{-6}. The salts used were the best quality supplied by Merck & Co. White rock-candy furnished the sugar. A solution of 30–50 per cent. was made, filtered through glass wool to remove the bits of string and kept tightly corked for use. The proper amount from the stock was taken for each solution made for a series. Iron, also, was kept in solution, but the other salts were weighed out as required. The formulae of the solutions are as follows:

A		C	
NH_4NO_3	1.00 gm.	Asparagine	0.50 gm.
K_2HPO_4	0.50 gm.	KH_2PO_4	0.50 gm.
$MgSO_4$	0.25 gm.	$MgSO_4$	0.25 gm.
$FeSO_4$	trace.	$FeSO_4$	trace.
Sugar	5.00 gm.	Sugar	5.00 gm.
Water	100.00 c.c.	Water	100.00 c.c.

The chloroform was the best grade made by Merck, known to contain .02 per cent. of absolute alcohol to prevent decomposition, which, however, in the quantities of the anaesthetic used is negligible. Repeated tests with $AgNO_3$ showed that no free Cl was present.

Sowing the fungus was accomplished by dipping the end of a clean glass rod into the nutrient solution, rubbing it over the dry spores, redipping it into the fluid, and agitating well to secure uniform distribution. The smooth white felts of the control cultures testified to the effectiveness of the treatment and the purity of the reagents. In practice, enough nutrient solution was made at a time for one complete series — the iron alone omitted. This solution was boiled, cooled and 50 c.c. taken in an accurate pi-

pette to be analyzed for acid and sugar. The remainder was then inoculated in bulk with spores in the method described and doses of 50 c.c. run from the pipette into each culture dish. Last of all the iron, a mere trace, was added.

The crop was reaped when the controls showed a full fruited surface. The felts were thrown on weighed filters, washed thoroughly with boiling water, dried in hot air at 70°–80° C., cooled in a desiccator and the dry weight ascertained. The filtrate made up to 250 c.c. was analyzed, as recorded, for oxalic acid, or sugar, or both. Determinations for oxalic acid in the filtrate from the *Sterigmatocystis* * were made at once. Ten cubic centimeters of the solution were titrated against standardized NaOH. The total acidity, less the acidity at the time of setting up (that of the stock solution), gave the correct amount of acid produced during growth.

A measured quantity of the filtrate, generally 100 c.c., was next inverted by boiling with 0.5 c.c. of 5N HCl and the invert sugar estimated by the Fehling test. When asparagine was present, extra care was taken. A cubic centimeter or 1.5 c.c. of acid was used for inversion and the time of boiling extended, water being added if necessary. Asparagine, by virtue of its amide groups, will reduce a copper solution and invalidate a test for sugar in its presence. Hard boiling with HCl serves to destroy the molecule with the production of NH_4Cl, which does not interfere with the analysis. The Fehling solution was kept in two portions. The stock $CuSO_4$ contained 69.28 gms. per liter; the alkaline tartrate, 100 gms. of NaOH and 350 gms. of $KNaC_4H_4O_6$ per liter. Standardization was made against accurately freshly prepared 1 per cent. dextrose. For each analysis 5 c.c. of each stock solution and 40 c.c. of H_2O were used. Calculations were made on the basis that under such conditions 0.5 gm. of invert sugar reduces 97 c.c. of the Fehling solution.†

The fruiting of the control cultures, as mentioned, determined the reaping of the crop. The period of growth varied with the temperature. Near its optimum of 34° C., *Sterigmatocystis* was

* Wehmer. Entstehung und physiologische Bedeutung der Oxalsäure im Stoffwechsel einiger Pilze. Bot. Zeit. **49**: 1891.

† Sutton. Volumetric Analysis. Ed. 1904.

ready to harvest in seven to ten days when grown on solution A, or in four to five days when asparagine replaced the NH_4NO_3; while the period of cultivation extended over two to three weeks if the temperature fell to 20°–25° C. The lack of constant conditions is to be regretted, especially in view of indications which may be discussed later.

The first effect of $CHCl_3$ used in such an amount as is necessary to cause noticeable stimulation is to retard the germination of the spores. With the smallest quantities employed, the first hyphae did not appear until six to twenty-four hours after growth had started in the chloroform-free air. The second effect seen is the production of toughened, buckled felts by a rapid growth accompanied by repression of conidial fructification, as observed also when the organism is stimulated by salts, etc. At harvesting, felts grown under optimum stimulation gave on an average crops 200 per cent. to 300 per cent. as heavy as the normal, rising in some instances to 500 per cent. and 700 per cent. The curve representing the influence of $CHCl_3$ on growth is similar to those of other stimulants; it rises in a characteristic manner to a maximum and then falls again.

Sterigmatocystis cultivated on solution A at a temperature varying between 20° and 30° C. grows more luxuriantly when the content of the atmosphere is, per liter, the vapor of $\frac{1}{3}$ c.c. of liquid $CHCl_3$ and the beneficial effect increases until $\frac{1}{2}$–$\frac{7}{12}$ c.c. per liter are used, when decrease begins. If the bell-jar contains per liter over 1 c.c. of $CHCl_3$ (vaporized), germination is permanently stopped, although the spores will grow readily if placed in air. When asparagine, instead of NH_4NO_3, is the source of nitrogen (solution C) the sensitivity of the *Sterigmatocystis* is increased. Optimum growth then takes place when $\frac{1}{6}$–$\frac{1}{4}$ c.c. of $CHCl_3$ is present per liter, and $\frac{2}{3}$ c.c. is sufficient to arrest development.

The augmentation in weight is accompanied by a relatively lessened acid formation and sugar consumption; that is to say, the ratio of the acid to the crop, and of the sugar used to the crop is lowered. For example, in Series X, Table I, the acid coefficient is lowered from 2.3186 to .4160 grams per gram fungus when the atmosphere held $\frac{1}{2}$ c.c. of $CHCl_3$ vaporized and to .3551 grams per gram fungus when the content was $\frac{7}{12}$ c.c.; at the same time,

the economic coefficient fell from 11.493 to 3.214 and 3.201 grams per gram fungus respectively. The average figures for the atmospheres quoted are for acid coefficient 0.6932 and 0.5696 and for sugar 3.744 and 3.514 against 1.4123 and 5.358 for the normal culture. The economic coefficient of the controls varies considerably from that found by Kunstmann * and Richards,† to be sure, but the figures obtained are fairly stable. The same thing is true of the data for oxalic acid as compared with those of Ono.‡ That irregular fluctuations may be regarded as due to individual peculiarities is indicated by the consistency in the various factors. For instance, a lack of due increase in weight is, in general, accompanied by an abnormal rise in the coefficients of acid and sugar, pointing to internal differences rather than to errors in calculation or manipulation.

Chloroform belongs to the so-called catalytics in Loew's § classification. The small amount absorbed by the water of the nutrient solution affects the protoplasm so as to cause it to work more economically, possibly through action on the enzyme formed.‖ However that may be, the figures point again to the explanation of the phenomena advanced by Richards¶ and by Ono** as his third alternative, *i. e.*, that the fungus can under the conditions produced by the stimulant thrive more economically.

The sensitivity of *Penicillium* on solution A is about equal to that of *Sterigmatocystis* on solution C.

Another question of interest is the stage in the growth at which the $CHCl_3$ is most potent. To learn this, series were run with the optimum of $CHCl_3$ placed in some when set up as before and in others after the spores had been allowed to start. The former were more prosperous (Table III); that is, the impulse given at germination is more effective than one applied later, but even after complete germination, the fungus responds, although in a lesser degree, in the characteristic fashion.

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* *L. c.*

† *L. c.*

‡ *L. c.*

§ Loew. "Naturliche System der Gift Wirkungen." Munich, 1893, as quoted by Davenport, Experimental Morphology, p. 7.

‖ Hueppe (*l. c.*) suggests this vaguely.

¶ *L. c.*

** *L. c.*

That chloroform cannot furnish carbon was settled by sowing spores on a solution of the necessary salts, but omitting sugar, and then placing in optimum chloroform conditions. Not a sign of a germ tube appeared even after two weeks' time.

Although there are no direct data on this point at present, still it is very evident to the worker that a given amount of chloroform is more efficacious at a higher than at a lower temperature, that the optimum point recedes as the temperature rises. It was impossible to keep the temperature of the room in which the cultures were grown constant for any considerable period, but the truth of the statement was many times manifest at various stages in the development. In one or two instances when the crop ripened at from 32–34° C., the optimum was pushed back from $\frac{1}{2}$–$\frac{7}{12}$ to $\frac{5}{12}$ or even $\frac{1}{3}$ c.c. per litre.

The facts indicated are, that:

1. When present in small quantities $CHCl_3$ vapor acts as a characteristic stimulant to the growth of *Sterigmatocystis nigra* and *Penicillium glaucum*.

2. Larger quantities are inimical or fatal.

3. Increased growth is attended by relatively less acid formation and less sugar consumption indicating greater economy in metabolism.

4. The time of greatest sensitiveness is at the germination of the spores.

5. $CHCl_3$ acts as a stimulant purely since it cannot be a source of carbon.

6. The effect of a given amount of the anaesthetic is greater as the temperature rises.

BARNARD COLLEGE, COLUMBIA UNIVERSITY,
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TABLE I.

Sterigmatocystis nigra.—SOLUTION A.

	$CHCl_3$. per li.	Net Weight.	Per Cent. Increase Over Normal.	Oxalic Acid by Weight	Oxalic Acid per gm Fungus.	Sugar Used.	Economic Coefficient.	
							Sugar: Fungus.	Fungus: Sugar.
	c.c.	grams.		grams.	grams.	grams.		
Series I.	0	.5836	—	.3942	.6754	2.7069	4.6378	.2156
Time 14 days.	0	.6628	—	.4097	.6181	3.0790	4.6454	.2152
Temp. 26°–33°C.	$\frac{1}{2}$	.7400	18.74	.2164	.2924	2.1130	2.8554	.3502
10% sugar sol.	$\frac{5}{12}$	.7360	18.10	.1597	.2170	2.2754	2.9820	.3353
	$\frac{1}{2}$	.6838	9.72	.2860	.4182	1.9804	2.8960	.3453
	$\frac{7}{12}$	.7088	13.73	.1468	.2071	1.9885	2.8054	.3564
Series II.	0	.1850	—	.1933	1.044	.7926	4.284	.2334
Time 12 days.	0	.2128	—	.1571	.7382	.8888	4.176	.2394
Temp. 24°–27°C.	$\frac{5}{12}$	.2950	48.31	.3622	1.227	1.3099	4.437	.2254
	$\frac{1}{2}$	.3314	66.62	.2566	.7743	1.5031	5.435	.2204
	$\frac{7}{12}$	.4216	111.9	.2203	.5225	1.6829	3.991	.2505
	$\frac{3}{4}$	.3110	56.36	.1764	.5672	1.3443	4.321	.2314
Series III.	0	.1806	—	.1996	1.105	.7502	4.164	.2407
Time 12 days.	0	.1294	—	.1585	1.224	.5492	4.487	.2228
Temp. 24°–27°C.	$\frac{5}{12}$	.5036	224.9	.1558	.3093	1.5577	3.091	.3309
	$\frac{1}{2}$	.4530	192.2	.1276	.2816	1.3916	3.072	.3255
	$\frac{7}{12}$	.2448	57.93	.0866	.3537	.6952	2.839	.3521
	$\frac{2}{3}$	.1598	3.10	.0618	.3867	.4482	2.804	.4488
Series IV.	0	.1750	—	.1392	.7954	.639	3.651	.2738
Time 12 days.	0	.0790	—	.0928	1.174	.281	3.557	.2811
Temp. 22°–28°C.	$\frac{1}{3}$	.2620	106.3	.1624	.6198	1.084	4.137	.2147
	$\frac{5}{12}$	.2710	113.4	.1753	.6468	1.080	3.985	.2509
	$\frac{1}{2}$	.2100	65.4	.1469	.6995	.833	3.966	.2521
	$\frac{7}{12}$	.2780	118.9	.1469	.5284	1.178	4.237	.2359
	$\frac{2}{3}$	.2226	75.3	.1005	.4535	1.062	4.770	.2096
	$\frac{3}{4}$	.1690	33.1	.1237	.7319	.813	4.810	.2078
Series V.	0	.0920	—	.1391	1.512	.462	5.021	.1991
Time 9 days.	0	.0640	—	.1121	1.751	.353	5.515	.1813
Temp. 26°–31°C.	$\frac{1}{3}$	.1170	50.0	.2589	2.212	.595	5.085	.1966
	$\frac{5}{12}$	.1550	98.7	.2705	1.745	.747	4.819	.2075
	$\frac{1}{2}$	.1370	75.6	.2628	1.918	.704	5.138	.1946
	$\frac{7}{12}$	.1590	103.8	.2551	1.604	.767	4.824	.2073
	$\frac{2}{3}$	.1110	44.3	.2164	1.949	.630	5.676	.1761
	$\frac{3}{4}$	.1750	124.3	.2056	1.174	.837	4.783	.2090
Series VI.	0	.0564	—	.0773	1.371	0.181	3.195	.3130
Time 7 days.	0	.0360	—	.0619	1.719	0.141	3.917	.2553
Temp. 27°–34°C.	$\frac{1}{3}$	.3650	690.0	.2783	0.762	1.480	4.055	.2466
	$\frac{5}{12}$	.2020	337.2	.1739	0.861	0.750	3.713	.2693
	$\frac{1}{2}$	.2720	488.7	.1662	0.611	0.623	2.290	.4366
	$\frac{7}{12}$	.2736	492.2	.1971	0.724	0.976	3.567	.2803
	$\frac{2}{3}$	.2256	388.3	.1469	0.651	0.623	2.761	.3621
	$\frac{3}{4}$	.2246	386.1	.1469	0.654	0.701	3.121	.3204

TABLE I.—*Concluded.*

Sterigmatocystis nigra.—SOLUTION A.

	$CHCl_3$ per li.	Net Weight.	Per Cent. Increase Over Normal.	Oxalic Acid by Weight.	Oxalic Acid per gm. Fungus	Sugar Used.	Economic Coefficient.	
							Sugar : Fungus.	Fungus : Sugar.
	c.c.	grams.		grams.	grams.	grams.		
Series VII.	0	.0200	—	.0541	2.705	.253	12.64	.0791
Time 10 days.	0	.0280	—	.0541	1.932	.290	10.35	.0967
Temp. 24°–30°C.	$\frac{1}{8}$	.1290	437.5	.1852	1.436	.574	4.453	.2246
	$\frac{1}{4}$	.1340	458.3	.0696	0.5194	.518	3.865	.2587
	$\frac{1}{2}$	.1952	713.3	.0812	0.4160	.627	3.214	.3111
	1	.1960	716.7	.0696	0.3551	.627	3.201	.3124
	$\frac{2}{4}$	.1854	672.5	.0696	0.3754	.653	3.520	.2841
	$\frac{3}{4}$	.1420	491.7	.0501	0.3528	.326	2.296	.4356
Series VIII.	0	.0570	—	.1314	2.305	.343	6.025	.1659
Time 13 days.	0	.0660	—	.1275	1.932	.361	5.462	.1830
Temp. 24°–30°C.	$\frac{1}{8}$	.0980	59.4	.1469	1.499	.488	4.984	.2006
	$\frac{1}{4}$	.1990	223.6	.0696	0.3497	.574	2.885	.3387
	$\frac{1}{2}$	.1810	194.3	.0773	0.4271	.713	3.940	.2538
	1	.2650	330.9	.0696	0.2626	.701	2.647	.3778
	$\frac{2}{4}$	.1880	205.7	.0503	0.2676	.427	2.287	.4408
	$\frac{3}{4}$	.1130	83.7	.0194	0.1717	.253	2.237	.4470
Series IX.	0	.0820	—					
Time 21 days.	0	.0987	—					
Temp. 23°–25°C.	$\frac{1}{8}$	.1810	101.3					
	$\frac{1}{4}$	.1930	114.7					
	$\frac{1}{2}$	.2508	178.9					
	1	.1510	68.0					
	$\frac{2}{4}$	.3594	299.8					
	$\frac{3}{4}$	.2390	165.9					

TABLE II.

AVERAGES OF DATA GIVEN IN TABLE I.

$CHCl_3$ per li.	Net Weight.	Per Cent. Increase Over Normal.	Oxalic Acid by Weight.	Oxalic Acid per gm. Fungus.	Sugar Used.	Economic Coefficient.	
						Sugar : Fungus.	Fungus : Sugar.
c.c.	grams.		grams.	grams.	grams.		
0	—	—	0.1563	1.4123	0.754	5.3579	0.2122
1/3	0.2702	209.0	0.2080	1.1368	1.056	4.2615	0.2388
1/2	0.2987	181.9	0.1796	0.7344	1.101	3.722	0.2771
1/2	0.3015	220.5	0.1756	0.6932	1.047	3.744	0.2924
1/2	0.2998	223.7	0.1490	0.5696	1.077	3.514	0.2966
3/4	0.2518	249.3	0.1174	0.6643	0.741	3.734	0.3076
3/4	0.1771	214.1	0.1091	0.6168	0.586	3.449	0.3239

TABLE III.

Sterigmatocystis nigra.—SOLUTION C.

	$CHCl_3$ per li.	Net Weight.	Sugar Used.	Economic Coefficient.	
				Sugar : Fungus.	Fungus : Sugar.
	c.c.	grams.	grams.		
Series X.	0	0.0596	1.167	19.58	0.0511
Time 7 days.	0	0.0340	1.167	34.32	0.0291
Temp. 25°–32° C.	1/12	0.0210	0.858	40.86	0.0245
	1/6	0 0290	0.858	29.59	0.0339
	1/4	0.1150	1.038	9.026	0.1108
	1/4	0.0720	0.930	12.91	0.0774
	5/12	0.0650	0.832	12.80	0.0781
	1/2	0.1120	0.930	8.303	0.1204
Series XI.	0	0.0886			
Time 7 days.	1/6	0.3106			
Temp. 30°–31° C.	5/12	0.3610			
	1/2	0.2340			
Series XII.	0	0.1910			
Time 4 days.	0	0.1660			
Temp. 32°–34° C.	1/6	0.2810			
	1/4	0.2860			
	1/3	0.1920			
Series XIII.	0	0.4470			
Time 4 days.	0	0.3520			
Temp. 27°–32° C.	1/12	0.2200			
	1/6	0.4660			
	1/4	0.5790			
	3/8	0.2130			
	5/12	0.2120			
	1/2	0.1980			

TABLE IV

Sterigmatocystis nigra.—SOLUTION A

	$CHCl_3$ per lt.	Net Weight.	Oxalic Acid by Weight.	Oxalic Acid per Gm. Fungus.	Sugar Used.	Economic Coefficient. Sugar: Fungus.	Economic Coefficient. Fungus: Sugar.
Series XIV.	c.c.	grams.	grams.	grams.	grams.		
Temp. 24°–31° C.	0	0.1470	0.1276	0.8680	0.477	3.245	0.3082
$CHCl_3$ in before germination, out after germination, *i. e.*, in 7 days. Total time 9 days.	0	0.0950	0.1044	1.099	0.274	2.884	0.3467
	$\frac{1}{12}$	0.3200	0.1121	0.3503	0.899	2.809	0.3559
	$\frac{1}{12}$	0.1500	0.0348	0.2320	0.365	3.063	0.4110
$CHCl_3$ after germination, *i. e.*, after 2 days; $CHCl_3$ in 10 days. Total time 12 days.	0	0.0840	0.1585	1.887	0.441	5.250	0.1905
	0	0.0794	0.1778	2.239	0.365	4.597	0.2175
	$\frac{1}{12}$	0.1240	0.0309	0.2492	0.404	3.258	0.3069
	$\frac{1}{12}$	0.2530	0.0619	0.2447	0.640	2.530	0.3953
Series XV.							
Temp 27°–32° C.	0	0.2200	0.1925	0.8750	0.957	4.350	0.2299
$CHCl_3$ in before germination, out after germination, *i. e.*, in 3 days. Total time 7 days.	0	0.1336	0.2040	1.527	0.777	5.816	0.1719
	$\frac{1}{12}$	0.2760	0.1584	0.5739	1.015	3.677	0.2719
	$\frac{1}{12}$	0.3040	0.1198	0.3941	0.996	3.431	0.2915
$CHCl_3$ in after germination, *i. e.*, after 2 days; $CHCl_3$ in 8 days. Total time 10 days.	0	0.1780	0.2744	1.542	0.936	5.258	0.1902
	0	0.1350	0.2435	1.804	0.751	5.563	0.1798
	$\frac{1}{12}$	0.0490	0.0154	0.3143	0.257	5.245	0.1907
	$\frac{1}{12}$	0.0280	0.0193	0.6893	0.257	9.178	0.1089
Series XVI.							
Temp. 23°–29° C.	0	0.0780					
$CHCl_3$ in before germination, in 4 days. Total time 14 days.	$\frac{1}{12}$	0.3730					
	$\frac{1}{12}$	0.1700					
$CHCl_3$ in after germination. In 14 days. Total time 16 days.	0	0.1190					
	$\frac{1}{12}$	0.2000					
	$\frac{1}{12}$	0.2676					
Series XVII.							
Temp. 26°–28° C.	0	0.0674					
$CHCl_3$ in before germination. In 4 days. Total time 8 days.	$\frac{1}{12}$	0.1470					
	$\frac{1}{12}$	0.1530					
$CHCl_3$ in after germination. In 12 days. Total time 12 days.	0	0.1040					
	$\frac{1}{12}$	0.0330					
	$\frac{1}{12}$	0.1040					

TABLE V

Penicillium glaucum.—SOLUTION A

	$CHCl_3$ per li.	Net Weight.	Sugar Used.	Economic Coefficient.	
				Sugar : Fungus.	Fungus : Sugar.
	c.c.	grams.	grams.		
Series XVIII.	0	0.0330	0.288	8.727	0.1145
Time 17 days.	0	0.0620	0.397	6.403	0.1561
Temp. 18°–26° C.	$\frac{1}{2}$	0.1320	0.726	5.500	0.1818
	$\frac{1}{4}$	0.1124	0.532	4.733	0.2112
	$\frac{1}{6}$	0.1054			
	$\frac{1}{8}$	0.0950	0.523	5.505	0.1816
	$\frac{5}{12}$	0.0540	0.302	5.592	0.1788
	$\frac{1}{3}$	0.0416	0.257	6.178	0.1618
Series XIX.	0	0.0664			
Time 14 days.	0	0.0930			
Temp. 19°–24° C.	$\frac{1}{12}$	0.0700			
	$\frac{1}{6}$	0.1580			
	$\frac{1}{4}$	0.2980			
	$\frac{1}{8}$	0.0400			
	$\frac{5}{12}$	0.0760			
	$\frac{1}{2}$	0.0400			
Series XX.	0	0.0490			
Time 19 days.	0	0.0534			
Temp. 21°–26° C.	$\frac{1}{12}$	0.0720			
	$\frac{1}{6}$	0.0950			
	$\frac{1}{4}$	0.0580			
	$\frac{1}{8}$	0.0268			
	$\frac{5}{12}$	0.0570			
	$\frac{1}{2}$	0.0300			

The Polyporaceae of North America — XI. A synopsis of the brown pileate species

WILLIAM ALPHONSO MURRILL

An attempt is made in the present paper to summarize in convenient form for reference the results of former studies covering all North American polypores having a distinct pileus with dark-colored substance, and, in addition, to give generic keys and diagnoses of new genera not already treated that come within this subgroup.

FAMILY POLYPORACEAE

Hymenophore annual or perennial: context fleshy-tough, corky or woody; hymenium poroid or lamelloid, fleshy to woody, never gelatinous.

Synopsis of the subfamilies

Hymenium porose.	
Hymenophore annual.	1. POLYPOREAE.
Hymenophore perennial.	2. FOMITEAE.
Hymenium furrowed.	3. AGARICEAE.

Subfamily 1. POLYPOREAE

Hymenophore varied in size and shape, fleshy-tough to corky, annual, sometimes reviving and rarely perennial in the tropics; surface encrusted or anoderm, glabrous or hairy, zonate or azonate: context fibrous, rarely punky, variously colored; tubes cylindrical, sometimes splitting into teeth, usually thin-walled: spores rounded or oblong, brown or hyaline, cystidia frequently present, surface of pileus never conidia-bearing: stipe often present, variously attached.

Synopsis of the Polyporeae with brown context

Hymenophore sessile.	
Spores hyaline.	
Context light-brown.	
Context at first fleshy, becoming slightly corky.	1. *Ischnoderma.*
Context tough from the first.	
Surface encrusted.	2. *Antrodia.*
Surface not encrusted.	
Surface glabrous or nearly so.	

Hymenium alveolate. 3. *Favolus.*
Hymenium normally poroid. 4. *Hapalopilus.*
Surface distinctly hairy.
Tubes large and irregular. 5. *Funalia.*
Tubes small and regular. 6. *Coriolopsis.*
Context dark-brown.
Context duplex, mostly of intricately woven black hairs. 7. *Trichaptum.*
Context simple.
Context friable. 14. *Phaeolus.*
Context tough.
Tubes yellow. 8. *Flaviporus.*
Tubes brown, rarely greenish.
Tubes entire, surface heavily bearded. 9. *Pogonomyces.*
Tubes soon splitting into teeth, surface velvety. 10. *Cerrenella.*
Tubes black. 11. *Nigroporus.*
Spores brown.
Hymenophore thin, dry, multizonate. 12. *Cyclomycetella.*
Hymenophore not as above. 13. *Inonotus.*
Hymenophore stipitate.
Spores hyaline. 14. *Phaeolus.*
Spores brown.
Pileus inverted, pendant. 15. *Coltriciella.*
Pileus erect, stipe central. 16. *Coltricia.*

1. ISCHNODERMA Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 38. 1879

Type: *Ischnoderma fuliginosum* (Scop.) Murr.

Hymenophore large, annual, epixylous, sessile; surface pelliculose, glabrous: context light-brown, fleshy to slightly corky, friable when dry; tubes small, thin-walled: spores smooth, hyaline.

Species: *I. fuliginosum* (Scop.) Murr. [see Bull. Torrey Club **31**: 606, 607. 1904.]

2. ANTRODIA Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 40. 1879

Type: *Antrodia mollis* (Sommerf.) Karst.

Hymenophore small, annual, epixylous, sessile or semi-resupinate; surface zonate, encrusted, glabrous: context thin, light-brown, fibrous; tubes short, firm, thin-walled: spores smooth, hyaline.

ANTRODIA MOLLIS (Sommerf.) Karst.

Daedalea mollis Sommerf. Suppl. Fl. Lapp. 271. 1826.
Trametes mollis Fr. Hym. Eur. 585. 1871.

Antrodia mollis Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 40. 1879.

Trametes stereoides Bres. Att. I. R. Accad. Sc. ed Art. III. **3**: 92. 1897.

According to Bresadola, this species is the same as *Polyporus stereoides* Fr. (Obs. Myc. **2**: 258. 1818), described from very small specimens collected on old fir trunks in Sweden, but different from *Polyporus cervinus* of Persoon (Myc. Eur. **2**: 87. 1825).

The plant is fairly well known in Europe and temperate North America on decaying wood of beech, maple, linden and other deciduous trees: Finland, *Karsten;* Hungary, *Kmet;* Tyrol, *Bresadola;* Canada, *Ellis, Macoun, Dearness;* Maine, *Blake;* New York, *Peck;* Ohio, *Lloyd.*

3. FAVOLUS Beauv. Fl. Owar **1**: 1. *pl. 1.* 1805

Type: *Favolus hirtus* Beauv.

Scenidium Kuntze, Revis. Gen. 515. 1893.

Type: *Favolus hirtus* Beauv.

Hymenophore small, annual, epixylous, sessile, dimidiate or reniform; surface multizonate, margin thin: context thin, leathery, pallid or brown; tubes alveolar: spores smooth, hyaline.

Species: *F. tenuis* (Hook.) Murr., *F. variegatus* (Berk.) Murr. [see Bull. Torrey Club **32**: 99–103. 1905]. Although typically white-fleshed, this genus contains brown forms and *F. variegatus* is usually brown.

4. HAPALOPILUS Karst. Rev. Myc. **3**: 18. 1881

Type: *Hapalopilus rutilans* (Pers.) Murr.

Hymenophore annual, very rarely perennial in the tropics, epixylous, sessile, dimidiate, simple or imbricate; surface anoderm, rarely pelliculose, zonate or azonate, usually brown and glabrous: context brown, leathery or corky, tough or rarely friable when dry; hymenium usually differently colored, tubes small, thin-walled: spores small, usually ovoid, hyaline.

Species: *H. rutilans* (Pers.) Murr., *H. sublilacinus* (Ell. & Ev.) Murr., *H. licnoides* (Mont.) Murr., *H. gilvus* (Schw.) Murr., *H. fulvitinctus* (B. & C.) Murr., *H. hispidulus* (B. & C.) Murr. [see Bull. Torrey Club **31**: 415–419. 1904].

5. FUNALIA Pat. Tax. Hymen. 95. 1900

Type: *Funalia Mons-Veneris* (Jungh.) Pat.

Hymenophore annual, epixylous, sessile, dimidiate, often semi-resupinate; surface anoderm, hairy: context light-brown, duplex, spongy above, coriaceous to woody below; tubes usually large, thin-walled, more or less lacerate: spores smooth, hyaline.

Synopsis of the North American species

1. Northern species; context thick, firm, tubes circular to angular, concolorous. 1. *F. stuppea.*
   Southern species, confined to the Gulf States and tropical America. 2.
2. Surface hairs small and simple, entire plant soft and flexible. 2. *F. villosa.*
   Surface hairs conspicuously branched and tufted, plant more or less rigid. 3. *F. cladotricha.*

1. **Funalia stuppea** (Berk.)

Trametes stuppeus Berk. Ann. Nat. Hist. **7**: 453. 1841.
Trametes Peckii Kalchb. Bot. Gaz. **6**: 274. 1881.

Described originally from Dr. Richardson's collections at Carlton House, British America, in 1841 and again forty years later from specimens collected by Irish on dead cottonwood trunks in Dakota. Kalchbrenner's description is translated by Peck as follows:

"Pileus corky, dimidiate, sessile, subdecurrent, hairy, zoneless, brownish-ferruginous, becoming pale, the margin acute; pores rather large, varying from rotund to angular, colored nearly like the pileus or when old becoming brown; substance wood-color."

This species is abundant in certain parts of northern and western North America on dead stumps and trunks of cottonwood and other species of poplar. What appears to be a modified form of the same plant has been found on dead willow trees in Kansas. Although similar, all forms of this species are distinct from *Trametes hispida* Bagl. of Europe.

British Columbia, *Macoun;* Montana, *Anderson;* Dakota, *Irish;* Colorado, *Crandall, Cowen;* Kansas, *Bartholomew;* Missouri, *Demetrio;* New Mexico, *Earle.*

2. **Funalia villosa** (Sw.)

Boletus villosus Sw. Prodr. 148. 1788. Fl. Ind. Occ. **3**: 1923. 1806.
Favolus villosus Fr. Syst. Myc. **1**: 344. 1821.
Polyporus villosus Fr. Epicr. 475. 1836–38.

Described originally from plants collected on dead trees in Jamaica as follows:

"B. acaulis, submembranaceus fasciatus griseo-albidus villosus, poris difformibus dentatis."

In his later work Swartz largely supplements the above description. Fries probably did not see the plant until after 1821. Resupinate Cuban forms were determined by Berkeley as *Polyporus cavernulosus* Berk. (Hook. Jour. Bot. **8**: 235. 1856), first described from Brazil, while semi-resupinate and pileate forms from tropical America and the Gulf States have long been known as *Polyporus versatilis* Berk. (Lond. Jour. Bot. **1**: 150. 1842), described originally from Cuming's collections in the Philippines.

This species is fairly common in the West Indies and Central America, and has been collected in quantity by Langlois in Louisiana. It appears to grow equally well on deciduous and coniferous wood, and varies much in appearance, consistency and size of pores, on all hosts.

Louisiana, *Langlois;* Florida, *Calkins;* Jamaica, *Earle 430;* Cuba, *Earle & Murrill 169, 294, 550, 598, 626;* Nicaragua, *Smith, Shimek.*

3. **Funalia cladotricha** (B. & C.)

Polyporus cladotrichus B. & C. Jour. Linn. Soc. Bot. **10**: 309. 1868.

Collected by Wright on dead wood in Cuba and thus described:

"Pileo dimidiato vel e decurrente reflexo strigoso brunneo; poris mediis angulatis, dissepimentis rigidis demum laceratis dentatis."

"Pileus 2–3 inches broad, 1–2 inches long; pores $\frac{1}{36}$ inch in diameter, 2 lines deep. The pileus has a spongy strigose coating, but not consisting of decumbent fibres as in the last (*P. trichomallus*). *P. endothrix* Berk., from the river Amazon, has much smaller pores."

SPECIES INQUIRENDAE

Polyporus Lindheimeri B. & C. Grevillea **1**: 50. 1872. Described from plants collected by Lindheimer on *Laurus Sassafras* in Texas as follows:

"Pileus $1\frac{1}{4}$ inch wide, $\frac{1}{2}$ long, often laterally confluent, dirty white, tinged with ash-color, floccose, here and there slightly strigose; hymenium cinereous; pores $\frac{1}{100}$ inch wide, angular."

The type of this species at Kew is very old and partially destroyed by insects, so that little can be known of the plant until new collections are made in the type locality.

6. **Coriolopsis** gen. nov.

Type: *Polyporus occidentalis* Kl. Linnaea **8**: 486. 1833.

Hymenophore thin, flexible or rigid, annual, epixylous, sessile, dimidiate, often largely resupinate; surface light-brown, zonate, anoderm, hairy, margin thin: context thin, coriaceous to woody, pale ferruginous, sometimes almost white; hymenium concolorous, tubes small, regular, thin-walled, entire: spores smooth, hyaline.

Synopsis of the North American species.

1. Pores conspicuous. 2.
   Pores inconspicuous, pileus papery, thin, very flexible. 1. *C. crocata.*
2. Pores yellowish-brown, pileus usually rather thick and firm. 2. *C. occidentalis.*
3. Pores white or pallid, pileus thin, often narrowly reflexed or entirely resupinate. 3. *C. gibberulosa.*

1. **Coriolopsis crocata** (Fr.)

Polyporus crocatus Fr. Epicr. 477. 1836–38.
Polyporus byrsinus Mont. Pl. Cell. Cuba 391. *pl. 15. f. 3.* 1842.
Polystictus crocatus Fr. Nov. Symb. 91. 1851.

Described originally from plants collected on trunks in Mexico by Liebmann. Confused with *C. occidentalis* by many, but plainly distinct. The species has until recently been but sparingly collected in tropical America, as the following specimens at hand will indicate.

Colombia, *Baker;* Nicaragua, *Wright 237, Smith;* Mexico, *Smith;* Cuba, *Wright 306½; Underwood & Earle 1580, Earle & Murrill 121, 125, 237, 351, 379, 499, 644.*

2. **Coriolopsis occidentalis** (Kl.)

Polyporus occidentalis Kl. Linnaea **8**: 486. 1833.
Polyporus lenis Lév. Ann. Sci. Nat. Bot. III. **9**: 123. 1848.
Polystictus cyclodes Fr. Nov. Symb. 90. 1851.

This species was first described from plants in Hooker's herbarium, collected on trunks in the island of St. Vincent by Guilding. *Polyporus lenis* was assigned to specimens collected on

trunks in America by Mougeot and *Polystictus cyclodes* to collections made in the island of San Jan by Oersted. These are probably not half of the names under which the species has been known.

The plant is exceedingly common on dead wood of various kinds throughout tropical America, the following list comprising only a few of the numerous collections examined:

Colombia, *Baker;* Yucatan, *Millspaugh;* Honduras, *Wilson, Brown;* Mexico, *Smith;* Jamaica, *Earle;* Cuba, *Earle, Murrill, Underwood, Britton, Shafer, Hamilton;* Porto Rico, *Earle.*

3. **Coriolopsis gibberulosa** (Lév.)

Polyporus gibberulosus Lév. Ann. Sci. Nat. Bot. III. **5**: 139. 1846.

Polystictus extensus Cooke; Sacc. Sylloge Fung. **6**: 244. 1888.

Described by Léveillé from Kegel's collections in Dutch Guiana and by Cooke from specimens named by Berkeley in the Hooker herbarium, collected in British Guiana. Cooke published Berkeley's name in Grevillea **14**: 82. 1886 without a description.

The species ranges northward in varying forms to Central America and the West Indies. The context is not white, but pale ferruginous. Specimens are at hand from Ecuador, *Lagerheim;* Colombia, *Baker;* Mexico, *Smith, Shimek;* Nicaragua, *Smith, Baker 2513;* Jamaica, *Earle 480;* Cuba, *Earle 548, 580, 1105, Underwood & Earle 1496, 1500, Earle & Murrill 30, 85, 119, 120, 128, 134, 136, 206, 214, 218, 223, 259, 330, 343, 368, 384, 394, 400, 418, 452, 645.*

SPECIES INQUIRENDAE.

Polyporus myrrhinus Kickx, Bull. Acad. Bruxell. **5**: 370. 1838.

Polystictus cascus Fr. Nov. Symb. 88. 1851.

Trametes rigida Berk. & Mont. Ann. Sci. Nat. Bot. III. **11**: 240. 1849. (*Polystictus rigens* Sacc. & Cub.; Sacc. Sylloge Fung. **6**: 274. 1888.)

7. TRICHAPTUM Murr. Bull. Torrey Club **31**: 608. 1904

Type: *Trichaptum trichomallum* (Berk. & Mont.) Murr.

Hymenophore annual, epixylous, sessile, dimidiate: context

brown, firm and leathery below, very loosely fibrous and darker above; tubes short, thin-walled, mouths polygonal, at times becoming labyrinthiform: spores smooth, hyaline.

Species: *T. trichomallum* (Berk. & Mont.) Murr. [see Bull. Torrey Club **31**: 608, 609. 1904].

8. **Flaviporus** gen. nov.

Type: *Polyporus rufoflavus* B. & C. Jour. Linn. Soc. Bot. **10**: 310. 1868.

Hymenium annual, often reviving, epixylous, sessile, dimidiate, imbricate; surface encrusted, glabrous: context thick, woody, brown; tubes thin-walled, minute, regular: spores smooth, hyaline.

Synopsis of the North American species

Hymenium pale lemon-yellow.	1. *F. rufoflavus.*
Hymenium deep orange-colored.	2. *F. crocitinctus.*

1. **Flaviporus rufoflavus** (B. & C.)

Polyporus rufoflavus B. &. C. Journ. Linn. Soc. Bot. **10**: 310. 1868.

Polyporus Braunii Rabh. Rabenhorst's Fung. Europ. Exsic. *no. 2005.*

Described from Wright's collections in Cuba. Known also from Venezuela through Fendler, and from Mexico through the collections of C. L. Smith. Plants later described as *P. Braunii* were found on palms, which were doubtless brought from tropical America. The name assigned by Berkeley refers to the red surface and bright-yellow hymenium of the plant.

2. **Flaviporus crocitinctus** (B. & C.)

Polyporus crocitinctus B. & C. Journ. Linn. Soc. Bot. **10**: 311. 1868.

The type, collected in Cuba by Wright, is well preserved at Kew. The species has not since been collected.

9. POGONOMYCES Murr. Bull. Torrey Club **31**: 609. 1904

Type: *Pogonomyces hydnoides* (Sw.) Murr.

Hymenophore annual, epixylous, dimidiate-sessile to flabelliform, thickly covered with rigid hairs: context dark-brown, punky; tubes short, thick-walled, light brown, mouths small, circular: spores smooth, hyaline.

Species: *P. hydnoides* (Sw.) Murr. [see Bull. Torrey Club **31**: 609, 610. 1904].

10. **Cerrenella** gen. nov.

Type: *Irpex tabacinus* B. & C. Grevillea **1**: 102. 1872.

Hymenophore thin, effused-reflexed, annual, epixylous; surface brown, zonate, anoderm, margin thin: context thin, coriaceous, brown; hymenium at first poroid, very soon becoming irpiciform, the teeth irregular and compressed: spores smooth, hyaline.

Synopsis of the North American species

Hymenium concolorous, teeth bright-brown in color. 1. *C. tabacina.*
Hymenium of a different color from the pileus, teeth covered with a greenish bloom. 2. *C. coriacea.*

1. **Cerrenella tabacina** (B. & C.)

Irpex tabacinus B. & C. Grevillea **1**: 102. 1872.

Described from plants collected by Curtis in the Carolinas. Its favorite host is decaying limbs of oak.

Ravenel, Fung. Car. 3: *22*; Georgia, *Ravenel*; Florida, *Lloyd, Calkins*; Louisiana, *Langlois*; Missouri, *Demetrio*..

2. **Cerrenella coriacea** (B. & Rav.)

Irpex coriaceus B. & Rav. Grevillea **1**: 101. 1872.

Described from Ravenel's South Carolina collections on dead oak branches. According to Berkeley, this species was described by Léveillé from Bogota as *Hydnum trachyodon* (Ann. Sci. Nat. III. **5**: 302. 1846) and was likewise found by Wright in Cuba (*I. trachyodon* B. & C. Jour. Linn. Soc. Bot. **10**: 326. 1868.

South Carolina, *Ravenel*; Alabama, *Peters*; Iowa, *Holway.*

SPECIES INQUIRENDAE

Irpex pityreus B. & C. Described from small specimens collected by Bennett in Rhode Island.

11. **Nigroporus** gen. nov.

Type: *Polyporus vinosus* Berk. Ann. Mag. Nat. Hist. II. **9**: 196. 1852.

Hymenium annual, epixylous, dimidiate-sessile to flabelliform, glabrous: context dark-brown, firm, homogeneous; tubes short, slender, thin-walled, black: spores smooth, hyaline.

Nigroporus vinosus (Berk.)

Polyporus vinosus Berk. Ann. Mag. Nat. Hist. II. **9**: 196. 1852.

Described from plants collected in San Domingo. The species is easily recognized by its wine-colored context.

Cuba, *Wright, Earle & Underwood 1574, Earle & Murrill 139.*

12. CYCLOMYCETELLA Murr. Bull. Torrey Club **31**: 422. 1904

Type: *Cyclomycetella pavonia* (Hook.) Murr.

Hymenophore annual, tough, epixylous, sessile, anoderm, zonate: context thin, fibrous, brown; tubes short, thin-walled, mouths polygonal, becoming concentrically elongated in some species by the splitting of the radial walls: spores ellipsoidal, smooth, ferruginous.

Species: *C. pavonia* (Hook.) Murr. [see Bull. Torrey Club **31**: 422, 423. 1904].

13. INONOTUS Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 39. 1879

Type: *Inonotus cuticularis* (Bull.) Karst.

Inoderma Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 39. 1879. Not *Inoderma* S. F. Gray 1821.

Type: *Inoderma radiatum* (Sow.) Karst.

Inodermus Quél. Ench. Fung. 173. 1886.

Type: *Inodermus hispidus* (Bull.) Quél.

Phaeoporus Schroet. Krypt. Fl. Schles. **3**: 489. 1888.

Type: *Inonotus cuticularis* (Bull.) Karst.

Hymenophore annual, epixylous, sessile, dimidiate, simple or somewhat imbricate, variable in size; surface usually anoderm, brown, hairy or glabrous: context brown, thin and fibrous to spongy or corky; hymenium concolorous, often covered with whitish powder in youth, tubes small, thin-walled: spores smooth, light to dark brown.

Species: *I. hirsutus* (Scop.) Murr., *I. perplexus* (Peck) Murr., *I. dryophilus* (Berk.) Murr., *I. texanus* Murr., *I. jamaicensis* Murr., *I. corrosus* Murr., *I. Wilsonii* Murr., *I. pusillus* Murr., *I. radiatus* (Sow.) Karst., *I. amplectens* Murr., *I. fruticum* (B. & C.) Murr. [see Bull. Torrey Club **31**: 593–601. 1904].

14. PHAEOLUS Pat. Tax. Hymen. 86. 1900

Type: *Phaeolus Schweinitzii* (Fr.) Pat.

Romellia Murr. Bull. Torrey Club **31**: 338. 1904.

Type: *Romellia sistotremoides* (Alb. & Schw.) Murr.

Hymenophore large, irregular, annual, spongy to corky, epixylous; stipe simple, variously attached, wanting at times; surface of pileus anoderm, hispid: context ferruginous, tubes irregular, thin-walled: spores ellipsoidal, smooth, hyaline; cystidia none.

This genus was founded on **Phaeolus sistotremoides** (Alb. & Schw.) Murr. and twelve other species, the majority of which I do not consider congeneric with the type. When I published the genus *Romellia* I was ignorant of the fact that *Phaeolus* had been raised from the subgeneric rank assigned it in 1897 (Ann. Bot. Buitenz. First Suppl. 112).

Species: *P. sistotremoides* (Alb. & Schw.) Murr. [see Bull. Torrey Club **31**: 338–340. 1904].

15. COLTRICIELLA Murr. Bull. Torrey Club **31**: 348. 1904

Type: *Coltriciella dependens* (B. & C.) Murr.

Hymenophore small, annual, tough, epixylous; stipe attached to the vertex of the pileus; surface of the pileus anoderm, zonate: context spongy, fibrous, ferruginous, tubes angular, one-layered, dissepiments thin: spores ellipsoidal, smooth, ferruginous.

Species: *C. dependens* (B. & C.) Murr. [see Bull. Torrey Club **31**: 348. 1904].

16. COLTRICIA S. F. Gray, Nat. Arr. Brit. Pl. **1**: 644. 1821

Type: *Coltricia perennis* (L.) Murr.

Strilia S. F. Gray, Nat. Arr. Brit. Pl. **1**: 645. 1821.

Type: *Strilia cinnamomea* (Jacq.) S. F. Gray.

Pelloporus Quél. Ench. Fung. 166. 1886.

Type: *Pelloporus triqueter* (Secr.) Quél.

Mucronoporus Ell. & Ev. Jour. Myc. **5**: 28. *pl. 8.* 1889.

Type: *Mucronoporus tomentosus* (Fr.) Ell. & Ev.

Onnia Karst. Finlands Basidsv. 326. 1889.

Type: *Onnia circinata* (Fr.) Karst.

Xanthochrous Pat. Cat. Tun. 51. 1897.

Type: *Xanthochrous tomentosus* (Fr.) Pat.

Hymenophore annual, terrestrial or humus-loving, simple, small to medium, usually circular and central-stemmed; surface anoderm, brown, zonate or azonate: context brown, coriaceous to spongy; hymenium concolorous, covered with yellowish or whitish powder when young, tubes thin-walled, at length fimbriate: spores smooth, rounded, ferruginous, cystidia rarely present.

Species: *C. cinnamomea* (Jacq.) Murr., *C. perennis* (L.) Murr., *C. parvula* (Kl.) Murr., *C. tomentosa* (Fr.) Murr., *C. obesa* (Ell. & Ev.) Murr., *C. Memmingeri* Murr. [see Bull. Torrey Club **31**: 340–348. 1904].

Subfamily 2. FOMITEAE

Hymenophore large, woody, perennial, rarely small or annual; surface anoderm or encrusted, usually sulcate, sometimes varnished: context punky or woody, variously colored; tubes cylindrical, usually thick-walled: spores rounded, smooth or verrucose, hyaline or brown, cystidia frequently present, surface conidia-bearing in a few species: stipe rarely present, the hymenophore usually being sufficiently elevated by its host.

Annual forms and species in a few genera connect this group with the *Polyporeae;* while the tendency at times to produce a daedaleoid hymenium, shown especially in *Porodaedalea*, connects it with the *Agariceae.*

Synopsis of the Fomiteae with brown context

Surface of the hymenophore covered with reddish-brown varnish, context corky. 1. *Ganoderma.*
Surface of the hymenophore not as above.
  Context olivaceous. 2. *Fomitella.*
  Context brown or dark-red.
    Hymenophore plainly stipitate, simple. 3. *Amauroderma.*
    Hymenophore subsessile, cespitose, arising from a common trunk or tubercle. 4. *Globifomes.*
    Hymenophore truly sessile, dimidiate or ungulate, simple or imbricate.
      Hymenium labyrinthiform, varying to porose, tubes not distinctly stratified. 5. *Porodaedalea.*
      Hymenium porose, tubes distinctly stratified.
        Pileus covered with a horny crust, context punky. 6. *Elfvingia.*
        Pileus not covered with a horny crust, or, if encrusted, context woody. 7. *Pyropolyporus.*
  Context dark-purple or black. 8. *Nigrofomes.*

1. GANODERMA Karst. Rev. Myc. **3**: 17. 1881

Type: *Ganoderma flabelliforme* (Scop.) Murr.

Placodes Quél. Ench. Fung. 170. 1886.

Type: *Ganoderma flabelliforme* (Scop.) Murr.

Hymenophore large, sessile or stipitate, perennial or annual, epixylous; surface sulcate, covered with reddish-brown varnish: context punky, brown, rarely pallid; tubes cylindrical, concolorous: spores ovoid, brown.

Species: *G. Tsugae* Murr., *G. flabelliforme* (Scop.) Murr., *G. sessile* Murr., *G. parvulum* Murr., *G. Oerstedii* (Fr.) Murr., *G. zonatum* Murr., *G. sulcatum* Murr., *G. nutans* (Fr.) Pat. [see Bull. Torrey Club **29**: 599–608. 1902].

2. **Fomitella** gen. nov.

Type: **Fomitella supina** (Sw.) Murr. (*Boletus supinus* Sw. Fl. Occ. Ind. **3**: 1926. 1806).

Hymenium sessile, at times semi-resupinate, applanate, epixylous; surface glabrous, anoderm to encrusted, sulcate with age: context woody or slightly punky, brownish-olivaceous, rarely varying to pallid; tubes minute, cylindrical, usually thick-walled, rarely stratose: spores smooth, hyaline.

Fomitella supina (Sw.)

Boletus resupinatus Sw. Prod. 149. 1788. Not *B. resupinatus* Fl. Dan. *pl. 844*.

Boletus supinus Sw. Fl. Occ. Ind. **3**: 1926. 1806.

Polyporus valenzuelianus Mont. Pl. Cell. Cuba 398. *pl. 15. f. 4.* 1842.

Polyporus guadelupensis Lév. Ann. Sci. Nat. Bot. III. **5**: 134. 1846.

Polyporus hemileucus B. &. C. Jour. Linn. Soc. Bot. **10**: 312. 1868.

Polyporus plebeius cubensis B. & C. Jour. Linn. Soc. Bot. **10**: 313. 1868.

The brief description originally given of this species in the Prodromus is slightly changed and much enlarged by the author in his Flora of the West Indies. He had in the meantime discovered that the plant is not always resupinate and that the earlier name was preoccupied. The habitat is here given as "Trunks of old trees in the mountains of Jamaica."

Montagne's description is characteristically complete and is accompanied by excellent figures. In commenting upon Berkeley's opinion that *P. valenzuelianus* is identical with *P. supinus* of Swartz, Montagne says that, if it is that species Swartz' name is "thoroughly inappropriate and repugnant." He then quotes Fries' comment in Novae Symbolae to the effect that the two species differ decidedly in color.

Only one specimen of *P. valenzuelianus*, so named, is to be found at Kew from the West Indies. The others are all from South Carolina and Georgia. In the United States, specimens have usually been determined as *P. hemileucus* B. & C., described originally from Cuba and identical with *P. valenzuelianus* and *P. supinus*.

Types of *P. plebeius cubensis* also agree with the above, though the specimens are older and more or less encrusted with a dark purplish covering.

Few polypores are more common in Cuba than this one and a good series of specimens showing nearly all known variations may often be picked from one log. There are, however, in the collection here some plants from Florida which show two variations not yet seen in specimens from elsewhere. Some of these have the context and pores nearly white, instead of olive-colored, and others show distinctly daedaleoid variations in the hymenium. How much the steam treatment used by Calkins may have affected these specimens it is difficult to say.

This species occurs on fallen deciduous wood throughout tropical America and the states bordering the gulf of Mexico, being found as far north as South Carolina.

Ell. & Ev. N. A. Fung. *1704;* Georgia, *Ravenel, Harper;* South Carolina, *Ravenel;* Alabama, *Earle, Baker, Underwood;* Louisiana, *Langlois, Lloyd;* Texas, *Hodson;* Florida, *Martin, Rau, Calkins, Rolfs, Ives;* Cuba, *Wright 252, Earle 153, Earle & Wilson 230, Earle & Underwood 588, 1123, 1501, 1525, Earle & Murrill 107, 205, 224, 230, 255, 342, 358, 360, 370, 483, 527, 593;* Porto Rico, *Earle 169, 171;* Jamaica, *Underwood 2324, 2832, 2835, Earle 245 a;* Nicaragua, *C. L. Smith 74.*

3. **Amauroderma** gen. nov.

Type: **Amauroderma regulicolor** (Cke.) Murr.

Hymenophore large, epixylous, stipitate, the stipe often much elongated; surface smooth, encrusted, not varnished: context brown, punky; tubes cylindrical, concolorous, the mouths usually light-colored at first: spores ovoid or globose, brown.

The generic name here employed was used by Patouillard (Tax. Hymen. 105. 1900) for a subdivision of the genus *Ganoderma*, referring to the *dark*, namely, *not shining*, surface of certain species. Members of the genus within our limits are confined to the tropics.

Synopsis of the North American species

1. Pileus less than 5 cm. in diameter, simple, tubes 8 to a mm. 1. *A. regulicolor.*
   Pileus 10 cm. or more in diameter. 2.
2. Stipe laterally attached, plants cespitose, tubes 5 to a mm. 2. *A. coffeatum.*
   Stipe centrally attached, plants simple, spores spherical, echinulate. 3. *A. Chaperi.*

1. **Amauroderma regulicolor** (Cooke)

Fomes regulicolor Cooke, Grevillea **15**: 21. 1886.

This species occurs on decaying roots in Cuba, but is probably rare, being known only from the original collections.

2. **Amauroderma coffeatum** (Berk.)

Polyporus coffeatus Berk. Ann. Nat. Hist. **3**: 385. 1839.

Described from Guilding's collections in the island of St. Vincent. The species grows on decaying trunks, and is known only from the type locality.

3. **Amauroderma Chaperi** (Pat.)

Ganoderma Chaperi Pat. Jour. Botanique **4**: 197. 1890.

Described from plants collected by Chaper in Cuba and deposited in the herbarium at Paris.

4. GLOBIFOMES Murr. Bull. Torrey Club **31**: 424. 1904.

Type: *Globifomes graveolens* (Schw.) Murr.

Hymenophore large, woody, encrusted, perennial, epixylous, compound: context ferruginous, punky; tubes cylindrical, thick-walled, stratose: spores ovoid, smooth, ferruginous.

Species: *G. graveolens* (Schw.) Murr. *l. c.*

5. **Porodaedalea** gen. nov.

Type **Porodaedalea Pini** (Thore) Murr.

Hymenophore large, perennial, epixylous, sessile, conchate to ungulate; surface anoderm, sulcate, usually rough: context brown and woody; tubes concolorous, rarely in distinct layers, the hymenium varying from porose to daedaleoid: spores smooth, hyaline at maturity, becoming brownish with age, cystidia conspicuous.

Porodaedalea Pini (Thore)

Boletus Pini Thore, Chlor. Land. 487. 1803. Brot. Fl. Lusit. **2**: 468. 1804.

Daedalea Pini Fr. Syst. Myc. **1**: 336. 1821; Linnaea **5**: 514. 1830.

Polyporus Pini Pers. Myc. Eur. **2**: 83. 1825.

Fomes Abietis Karst. Bidr. Finlands Nat. och Folk **37**: 242. 1882.

Polyporus piceinus Peck, Rept. N. Y. State Mus. Nat. Hist. **42**: 25. 1889.

Trametes Pini Abietis Karst. Finlands Basidsv. 336. 1889.

This abundant and variable species was transferred to *Mucronoporus* by Ellis on account of its spiny hymenium, but it is best known as a *Trametes*. Besides its published specific names several manuscript names have been assigned to it, among which are *Polyporus gausapatus* Berk. & Rav. on pine, *Daedalea vorax* Harkness on *Abies Douglasii* in California and *Daedalea vetusta* Ell. & Hark., on white cedar in New Jersey.

It seems that this plant is more sensitive to changes in host than almost any other of its kind. One would expect a parasitic species like this to show more variation than an ordinary dead-wood species, but the forms here assumed on different hosts and even on the same host under different conditions are surprising. I am supposing that the range of forms found on pine, spruce and other conifers represent a single species. They have all seemed so to me, and Dr. Schrenk expects shortly to prove their identity by the completion of a series of inoculation experiments covering various hosts.

The present species is too well known throughout both Europe and America as a destructive parasite of coniferous trees to require a list of specimens collected. All published exsiccati covering the group contain it and fresh material may be gathered in almost any locality.

6. ELFVINGIA Karst. Finlands Basidsv. 333. 1889.

Type: *Elfvingia lipsiensis* (Batsch) Murr.

Xylopilus Karst. Bidr. Finlands Nat. och Folk **37**: 69. 1882.

Type: *Xylopilus crassus* (Fr.) Karst.

Hymenophore large, epixylous, sessile, applanate or ungulate; surface sulcate, horny-encrusted: context brown, punky; tubes brown, cylindrical, stratose, thick-walled, mouths whitish when young: spores brown, rarely hyaline; conidia present in most species on the surface of the pileus.

Species: *E. fomentaria* (L.) Murr., *E. fasciata* (Sw.) Murr., *E. reniformis* (Morg.) Murr., *E. megaloma* (Lév.) Murr., *E. tornata* (Pers.) Murr., *E. Lionnetii* (Rolland) Murr. [see Bull. Torrey Club **30**: 296-301. 1903].

An examination of Schweinitz' type has shown his *Polyporus lobatus* to be a somewhat distorted form of *Elfvingia reniformis*. *P. lobatus* Schw. is not tenable, however, because of *P. lobatus* Schrad.

7. PYROPOLYPORUS Murr. Bull. Torrey Club **30**: 109. 1903.

Type: *Boletus igniarius* L.

Mison Adans. Fam. **2**: 10. 1763. Not associable with a binomial species.

Type: *Boletus igniarius* L. (Micheli's *pl. 62*).

Agaricon Adans. Fam. **2**: 10. 1763. Not *Agaricus* L. 1753.

Type: *Boletus igniarius* L. (Tournefort's *pl. 333*).

Phellinus Quél. Ench. Fung. 172. 1886. Not *Phelline* Poir. 1826.

Type: *Boletus igniarius* L.

Hymenophore large, perennial, epixylous, sessile, ungulate or applanate; surface sulcate, usually anoderm and often rough or rimose: context woody or punky, brown, rarely dark-red; tubes brown, cylindrical, stratose, usually thick-walled: spores smooth, ferruginous, rarely hyaline.

Species: *P. igniarius* (L.) Murr., *P. fulvus* (Scop.) Murr., *P. crustosus* Murr., *P. Calkinsii* Murr., *P. Everhartii* (Ell. & Gall.) Murr., *P. Robiniae* Murr., *P. praerimosus* Murr., *P. Underwoodii* Murr., *P. juniperinus* (Schrenk) Murr., *P. Earlei* Murr., *P. conchatus* (Pers.) Murr., *P. Haematoxyli* Murr., *P. Langloisii* Murr., *P. Ribis* (Schum.) Murr., *P. yucatanensis* Murr., *P. senex* (Nees & Mont.) Murr., *P. linteus* (B. & C.) Murr., *P. jamaicensis* Murr. [see Bull. Torrey Club **30**: 109–120. 1903].

8. NIGROFOMES Murr. Bull. Torrey Club **31**: 425. 1904.

Type: *Nigrofomes melanoporus* (Mont.) Murr.

Hymenophore large, perennial, epixylous, sessile: context woody, purple; tubes cylindrical, stratose, thick-walled, black: spores ovoid, smooth, hyaline.

Species: *N. melanoporus* (Mont.) Murr. *l. c.*

Subfamily 3. AGARICEAE

Hymenium annual, very rarely perennial, coriaceous to woody, variable in size; surface anoderm, hairy or glabrous, variously marked: context white or brown, fibrous, woody or punky; hymenium exceedingly variable, normally labyrinthiform or lamelloid, but often poroid or even irpiciform, never stratified: spores smooth, brown or hyaline.

Poroid and irpiciform plants of this group are difficult to separate from certain species of the *Polyporeae*; forms of *Agaricus confragosus* in particular being troublesome to the beginner. On

the other hand, there is little to cause confusion between this group and the *Fomiteae*, if we except the single distinctly perennial species of *Agaricus* and the daedaleoid forms of *Porodaedalea*.

Synopsis of the Agariceae with brown context

Hymenophore sessile, furrows radiate.	1. *Gloeophyllum*.
Hymenophore stipitate, furrows concentric.	2. *Cycloporus*.

1. GLOEOPHYLLUM Karst. Bidr. Finlands Nat. och Folk **37**: x, 79. 1882

Type: *Sesia hirsuta* (Schaeff.) Murr.

Sesia Adans. Fam. **2**: 10. 1763. Not associable with a binomial species.

Type: *Sesia hirsuta* (Schaeff.) Murr.

Serda Adans. Fam. **2**: 11. 1763. Not associable with a binomial species.

Type: *Sesia hirsuta* (Schaeff.) Murr.

Lenzitina Karst. Finlands Basidsv. 337. 1889.

Type: *Sesia hirsuta* (Schaeff.) Murr.

Hymenophore small, annual, epixylous, sessile; surface hairy or glabrous, anoderm, often zonate: context tough, brown; hymenium normally lamelloid or daedaleoid, but frequently poroid in some species: spores smooth, hyaline.

According to the rules now followed by most American botanists *Sesia* must be replaced by *Gloeophyllum*, as follows:

Species: *Gloeophyllum hirsutum* (Schaeff.) Murr., **Gloeophyllum Berkeleyi** (Sacc.) Murr., **Gloeophyllum striatum** (Sw.) Murr., **Gloeophyllum pallidofulvum** (Berk.) Murr. [see Bull. Torrey Club **31**: 602–606. 1904].

2. CYCLOPORUS Murr. Bull. Torrey Club **31**: 423. 1904

Type: *Cycloporus Greenei* (Berk.) Murr.

Hymenophore annual, tough, anoderm, terrestrial, centrally stipitate: context soft, spongy, ferruginous; pores at first polygonal, soon becoming continuous concentric furrows, dissepiments thin, lamelloid: spores ovoid, smooth, ferruginous.

In publishing the above genus I neglected to state that the name had been previously used by Patouillard for a subgenus of his genus *Xanthochrous* (Ann. Bot. Buitenz. First Suppl. 113. 1897).

Species: *C. Greenei* (Berk.) Murr. *l. c.*

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NEW YORK BOTANICAL GARDEN.

Further notes on the orchids of central New York*

HOMER DOLIVER HOUSE

A previous list of the Orchidaceae of central New York† was based mainly upon herbarium specimens examined in the herbarium of Columbia University, the New York Botanical Garden, a lesser number in my own collection and certain records in Paine's catalogue of Oneida County plants (1865). It was evident at the time that the record was a very incomplete one and that several changes in nomenclature were necessary. The purpose of the present paper is to augment the known localities for some of the rarer orchids of that region, the result of further collection and study of specimens in various herbaria, together with authentic reports not previously given, and to make some necessary changes in their nomenclature. In the citations of specimens, N designates the National herbarium; C, Columbia University; Y, New York Botanical Garden; S, Syracuse University; and H, the author's herbarium. Species starred are new to the region and were not given in my previous list.‡

CRIOSANTHES Raf. Am. Monthly Mag. 268. 1818.
Journ. de Phys. **89**: 102. 1819.

This generic segregate of *Cypripedium* was recognized also by Beck in 1833, and Pfitzer recognizes it as a section of *Cypripedium*. Its evident characters are the separate sepals and the prolongation of the lip at the apex into a long blunt spur, which is distorted at the upper end, giving rise to the common name, ram's-head lady's-slipper.

Arietinum Beck, Bot. N. & Middle U. S. 352. 1833.

Arietina, Sect. of *Cypripedium*, Pfitz.; Engl. & Prantl, Planzenfam. 2^6: 83. 1888.

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† Torreya **3**: 49. Ap 1903.

‡ Since the present paper was written, Dr. J. V. Haberer has published in Rhodora (May and June, 1905) some notes on "Plants of Oneida County, New York, and Vicinity," in which records of the following orchids occur: ***Achroanthes unifolia***, ***Blephariglottis grandiflora***, ***Corallorhiza multiflora flavida***, ***Peramium tessellatum***, and ***Peramium ophioides***.

Criosanthes arietina (R. Br.)

Cypripedium arietinum R. Br.; Ait. Hort Kew. ed. 2, **5**: 222. 1813.

Criosanthes borealis Raf. Am. Monthly Mag. 268. 1818.

Arietinum americanum Beck. Bot. N. & Middle U. S. 352. 1833.

Range: Quebec to Ontario, New York and Minnesota.

ONONDAGA CO.: "Near Syracuse," *Beauchamp*. Cicero Swamp, *House*, 1902, (H). HERKIMER CO., "Mud lake near Jordanville," *Haberer*.

CYPRIPEDIUM L.

Considerable interest attaches to the group of yellow lady's-slippers on account of Dr. P. A. Rydberg's article * which brings up the question as to whether there are three species of yellow-flowered Cypripediums instead of two, as commonly given in recent manuals. An examination of fresh specimens during two seasons since, leads me to believe, "we do have three species of yellow lady's-slippers, one large and one small-flowered, both with vertically flattened lip, and a third . . . one with laterally flattened lip." I must, however, differ somewhat from the accepted treatment of their nomenclature.

CYPRIPEDIUM PUBESCENS Willd. Sp. Pl. **4**: 143. 1805. Hortus Berolinensis **1**: *pl. 13*.

C. bulbosum Mill. Gard. Dict., ed. 8, no. 2. 1768. Not L. 1753.

C. Calceolus Walt. Fl. Car. 222. 1788. Michx. Fl. Bor.-Am. **2**: 161. 1803. Not L. 1753.

C. luteum Ait; Raf. Med. Fl. 140. *pl. 30*. 1828.

C. hirsutum Britton & Brown, Illus. Flora; Britton's Manual and other recent reports, but not Miller, 1768.

This is the common large yellow lady's-slipper, and would bear Miller's name, were that name not antedated by *C. bulbosum* of Linnaeus.

CYPRIPEDIUM PARVIFLORUM Salisb. Trans. Linn. Soc. **1**: 77. *pl. 2. f. 2*. 1791. Also of Gray's Manual, but not of Britton's Manual.

Differs from *C. pubescens*, apparently in size only, and is usually found in more swampy situations than *C. pubescens*. Conservative treatment may reduce this to a variety of *pubescens*.

* Torreya **2**: 84. Je 1902.

* CYPRIPEDIUM FLAVESCENS DC.; Redouté, Lil. **1**: *pl. 20.* 1802.

C. parviflorum Sims, Bot. Mag. **23**: 911. 1806.—Britton, Manual 291. 1901. Not Salisb.

C. pubescens Sweet, Brit. Flow. Gard. **1**: *pl. 71.* 1823.—A. Gray, Manual. Not Willd.

Distribution: Quebec and New England to Montana and Washington, south in the mountains to West Virginia.

A species of shady ravines and moist rich woodlands, of decidedly more boreal distribution than the last, which seems to follow quite closely the range of *C. pubescens* Willd. In addition to the laterally flattened (the greatest expansion being vertical) lip, the lip is often subglobose and conspicuously ascending, and the leaves narrower and more ascending, than in the other yellow-flowered species of our flora.

CYPRIPEDIUM HIRSUTUM Miller, Gard. Dict. ed. 8, no. 3. 1768

C. reginae Walt. Fl. Car. 222. 1788.—Britton & Brown, Illus. Fl. **1**: 458. 1896.—Britton, Manual, 291. 1901.—Small, Fl. Southeastern U. S. 311. 1903.

C. album Ait. Hort. Kew. **3**: 303. 1789.

C. spectabile Salisb. Trans. Linn. Soc. **1**: 78. *pl. 3. f. 3.* 1791. Also of Gray's Manual.

C. canadense Michx. Fl. Bor.-Am. **2**: 161. 1803.

The error of crediting Miller's name *C. hirsutum*, to a yellow-flowered species has been quite prevalent in recent publications. Fox (Bull. Geol. Nat. Hist. Surv. Minn. **9**: 423–449. 1895) uses Miller's name for a yellow-flowered species, but whether the mistake originated with his use of the name is not certain, as he gives no authority for his usage.

In support of the present usage of the name *hirsutum*, I would quote Miller himself: "The third sort [*C. hirsutum*] grows naturally in America where the inhabitants call it the moccasin flower. This rises a foot and a half high. The leaves are of an oblong oval form and are deeply veined. The flower is large, of a reddish brown color, marked with a few purple veins." The height of the plant described precludes its being referred to *C. acaule* Ait. The name moccasin-flower was a name applied to both species and is still so used by country folk, but restricted in recent books to *C. acaule*.

FISSIPES ACAULE (Ait.) Small

Cypripedium acaule Ait.

A form with pure white flowers is reported from Beaver Lake, Onondaga Co., by *Rev. W. M. Beauchamp.*

PERULARIA FLAVA (L.) Rydb.

Apparently not so rare as at first reported. "Frequent in marshes," *Beauchamp.* Near Syracuse, *F. C. Straub*, 1891 (N). Near Oneida, *House*, 1903 (H).

COELOGLOSSUM BRACTEATUM (Willd.) Parl.

ONONDAGA Co.: "Baldwinsville," *Beauchamp.* MADISON Co.: Cazenovia, *M. C. Conner* (S). HERKIMER Co.: *Frank Tweedy*, 1879 (N); near Newport, *House*, 1901 (H).

LYSIAS ORBICULATA (Pursh) Rydb.

ONONDAGA Co.: "Skaneateles Lake," *Beauchamp;* Jamesville, *House*, 1903 (H). ONEIDA Co.: Lee, *Brower* (C); Sylvan Beach, *House*, 1903 (H).

BLEPHARIGLOTTIS BLEPHARIGLOTTIS (Willd.) Rydb.

ONONDAGA Co.: "Abundant at Beaver Lake," *Beauchamp.* HERKIMER Co.: "Frankfort Hill," *Haberer.*

MADISON Co.: Fiddler's Green, *House*, 1905, *no. 1246* (H).

* BLEPHARIGLOTTIS GRANDIFLORA (Bigel.) Rydb.

MADISON Co.: Oneida, *House*, 1903 (H). ONEIDA Co.: swamps west of Fort Bull, Rome, *Paine* (C). HERKIMER Co.: "Northern part of the county," *Calverly* in Paine's Cat. (1865). (*Habenaria fimbriata* A. Gray.)

BLEPHARIGLOTTIS LEUCOPHAEA (Nutt.) Rydb.

ONONDAGA Co.: Marshy meadows near Carpenter's Pond, Fabius, *House*, 1903 (H).

* LIMNORCHIS MAJOR (Lange) Rydb.

This species must be credited to central New York with some doubt; there is a specimen in the Columbia University herbarium, collected by Dr. Asa Gray, locality not indicated, but probably in central New York.

LIMNORCHIS DILATATA LINEARIFOLIA Rydb.

MADISON CO.: Near Chittenango, *House*, 1903 (H).

* LIMNORCHIS MEDIA Rydb.

HERKIMER CO.: Jordanville, *Peck* (Ann. Rep. 20. 1902).

LYSIELLA OBTUSATA (Pursh) Rydb.

ONONDAGA CO.: Carpenter's Pond, Fabius, *House*, 1903 (H).

* PERAMIUM OPHIOIDES (Fernald) Rydb.

ONONDAGA CO.: Green Pond near Jamesville, *House*, 1903 (H).

LIMODORUM TUBEROSUM L.

Forms with pure white flowers reported from Cicero Swamp, Onondaga Co., by Mrs. M. O. Rust.

APLECTRUM

As indicated by Dr. J. H. Barnhart (Torreya **4**: 119–121. Au 1904) the *Aplectrum spicatum* of B.S.P. and of Britton's Manual, should be restored to the former name *A. hyemale* (Willd.) Nutt., and *A. spicatum pallidum* House, becomes *A. hyemale pallidum* (House) Barnhart.

ISOTRIA VERTICILLATA (Willd.) Raf.

ONEIDA CO.: Rome, *J. A. Paine, Jr.* (S). ONONDAGA CO.: Lysander, *O. E. Pearce*, 1885 (N); Kirkville, *House*, 1902 (H). OSWEGO CO.: *C. S. Sheldon*, 1879 (N). MADISON CO.: Fiddler's Green, *House*, 1905, *no. 1248* (H).

POGONIA OPHIOGLOSSOIDES (L.) Ker

ONEIDA CO.: Rome, *Bingham* (S). OSWEGO CO.; North Hannibal, *O. E. Pearce*, 1883 (N). ONONDAGA CO.: Canandaigua, *Mrs. Antisell*, 1881 (N).

TRIPHORA TRIANTHOPHORA (Swartz) Rydb.

ONONDAGA CO.: Kirkville, *Underwood* (S); "Beaver Lake," *Beauchamp; Mrs. M. O. Rust*, 1879 (N).

ARETHUSA BULBOSA L.

ONONDAGA CO.: "Cicero Swamp, Beaver Lake and Labrador Bog," *Beauchamp;* East of Syracuse, *F. Bell* (N); *H. D. House*, 1902 (H).

ACHROANTHES MONOPHYLLA (L.) Greene.

ONONDAGA CO.: "Otisco," *Beauchamp*. ONEIDA CO.: Bridgewater (C); Taberg, *Peck* (Ann. Rep. 35. 1894).

OPHRYS (Tourn.) L.

Diphyllum Raf. Med. Repos. **5**: 357. 1808; fide Kuntze, Rev. Gen. **2**: 659. 1891.

Listera R. Br.; Ait. Hort. Kew. ed. 2, **5**: 201. 1813. Not *Listera* Adans. 1763.

Distomaea Spenn. Fl. Friburg **1**: 245. 1825.

The following statement regarding the genus *Ophrys* is contributed by Mr. W. F. Wight of the Bureau of Plant Industry, United States Department of Agriculture.

"The genus *Ophrys* as established by Linnaeus in the Species Plantarum (945. 1753) included fifteen species. In the fifth edition of his Genera Plantarum, Linnaeus adopted the genus from Tournefort (Inst. 437. *pl. 250.* 1700) with a slight change in spelling, Tournefort having written it *Ophris*. The five species included by Tournefort were named by Linnaeus in the Species Plantarum *O. ovata*, *O. lilifolia*, *O. ovata β*, *O. paludosa*, and *O. cordata*, respectively. None of these species belongs to *Ophrys* as generally accepted by modern authors, but the name is retained instead for the last Linnaean species, *O. insectifera*, which Tournefort placed not in *Ophris*, but in *Orchis*.

"The type of *Ophrys* must be one of the five original species placed in this genus by Tournefort and cannot be a species which that author placed in *Orchis*. In accordance with the code of nomenclature proposed (1904) by the Botanical Club of the American Association for the Advancement of Science, the type of *Ophrys* is the first Linnaean species included by Tournefort and also figured by him. This species is *Ophrys ovata*, and the retention of this species as the type of the genus *Ophrys* is a treatment which accords with that of several authors among whom the following are noteworthy:

"SCOPOLI, Flora Carniolica **2**: 205. 1772, restricted *Ophrys* to three species, *O. Nidus-Avis*, *O. ovata* and *O. cordata*, and referred *insectifera* to *Orchis*.

"HOFFMANN, Deutschlands Flora 177. 1804, added to Scopoli's species of *Ophrys* a fourth, *O. corallorhiza*, and recognized *Arachnites* published by F. W. Schmidt (Fl. Boem. **1**: 74. 1793) as the name of the genus called *Ophrys* by modern authors.

"TODARO, Nuov. Gen. 12. 1858, discusses the genera *Arachnites* and *Ophrys* and limits the latter to *Ophrys ovata* and its congeners.

"The name *Listera* commonly applied to this genus was published by Robert Brown in 1813 and is a homonym of *Listera* Adanson 1763, proposed for a genus belonging to the family Fabaceae."

The most recent treatment of the genus *Listera* R. Br. is by K. Wiegand (Bull. Torrey Club **26**: 157–171. 1899) where all the known species are described and illustrated. The name *Diphyllum* proposed by Rafinesque in 1808 is taken up by Kuntze for this genus, but Thos. Morong (Bull. Torrey Club **20**: 29. 1893) shows that it can not be referred with any degree of certainty to *Listera* of R. Brown. *Distomaea* Spenner 1825, is based upon *Ophrys cordata.*

The two species previously reported from central New York are:

OPHRYS CORDATA L. Sp. Pl. 946. 1753.
Listera cordata R. Br.; Ait. Hort. Kew. ed. 2, **5**: 201. 1813.
Distomaea cordata Spenn. Fl. Friburg **1**: 245. 1826.

ONONDAGA Co.: Syracuse, *Underwood*, 1889 (C.); "Baldwinsville," *Beauchamp*. MADISON Co.: Fenner, *Underwood* (S). Reported by Paine (1865) from Oneida and Herkimer counties.

Ophrys australis (Lindl.) House

Listera australis Lindl. Gen. & Spec. Orch. 456. 1840.

The occurrence of this southern species in central New York is discussed by K. Wiegand in Bull. Torrey Club **26**: 159. 1899.

ONONDAGA Co.: Beaver Lake near Baldwinsville, *Beauchamp* (C), *Underwood*, *O. E. Pearce*, 1885. OSWEGO Co.: "Lily Marsh," *J. H. Wibbe*, 1876; *C. S. Sheldon*, 1879.

A third species not previously reported is,*

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* Two other species of *Ophrys* are found in the eastern United States:

Ophrys auriculata (Wiegand) House

Listera auriculata Wiegand, Bull. Torrey Club **26**: 166. *pl. 356. f. 2.* 1899.

Ophrys Smallii (Wiegand) House

Listera reniformis Small, Bull. Torrey Club **24**: 334. 1897. Not G. Don.
Listera Smallii Wiegand, Bull. Torrey Club **26**: 169. *pl. 357. f. 7.* 1899.

*** Ophrys convallarioides** (Swartz) Wight

Epipactis convallarioides, Swartz, Kongl. Vet. Acad. Handl. II. **21**: 232. 1800.

Listera convallarioides Torr. Comp. 320. 1826.

HERKIMER Co.: Cold woods of the higher hills, Newport, *House*, 1903 (H).

IBIDIUM Salisb. Trans. Hort. Soc. **1**: 281. 1812

Aristotelea Lour. Fl. Cochinch. 522. 1790. Not *Aristotela* Adans. 1763.

Gyrostachis Pers. (in text, Syn. **2**: 511. 1807); *Gyrostachys* Kuntze, Rev. Gen. **2**: 664. 1891.

Spiranthes L. C. Richard Mém. Mus. Paris **4**: 42. 1818.

Considerable difference of opinion regarding the generic name of our species of "ladies' tresses" exists among recent American authors. The earliest name, *Orchiastrum* Micheli, is taken up by Professor Greene (Manual Bay Reg. Bot. 305. 1894). Kuntze's usage of the name *Gyrostachys* is followed by Britton & Brown (Illus. Flora **1**: 470. 1896), Britton's Manual (299. 1901) and by Small (Flora Southeastern U. S. 317. 1903), while the name *Spiranthes* L. C. Rich., in usage prior to these authors, is again taken up by Ames (Orch. 113. 1905).

The name *Gyrostachys* is questionably published in text and no combinations are made by Persoon with this name. Regarding three of his species of *Neottia* (*spiralis*, *aestivalis*, and *tortilis*) Persoon makes this observation after the first:

"Obs. An ob spicam tortilem et labellum crenulatum cum 2-sequentibus, genere distinguenda? (*Gyrostachis*)."

It is quite evident therefore that *Gyrostachis* is not a published genus and under the new code of nomenclature proposed by the Botanical Club of the American Association, cannot be taken up. Were there not an earlier name based upon a well-known species, Richard's name *Spiranthes* (1818) would be the accepted name. The type of *Ibidium* Salisb. (1812) is *I. spirale* Salisb. (*Spiranthes autumnalis* Richard, *S. spiralis* C. Koch), a species congeneric with those of the eastern United States herein treated under the name *Ibidium*.

The following species of *Ibidium* have been reported from central New York, under *Gyrostachys* of my previous list.

Ibidium strictum (Rydb.)

Gyrostachys stricta Rydberg, Fl. Montana 107. 1900. Britton, Manual 299. 1901.

This species, related to the Alaskan *S. Romanzoffiana* Cham., is merged with the latter by Oakes Ames (Orch. 138. 1905).

Ibidium plantagineum (Raf.)

Neottia plantaginea Raf. Am. Monthly Mag. **2**: 206. 1818.
Spiranthes plantaginea Torr. 1843. Not Lindl.
S. latifolia Torr., Lindl. 1840.
Gyrostachys latifolia Kuntze. 1891.
G. plantaginea Britton. 1896.

The commonest species of the genus in central New York, occurring in almost every bog and swampy place.

Ibidium cernuum (L.)

Ophrys cernua L. Sp. Pl. 946. 1753.
Spiranthes cernua Rich. 1817.
Gyrostachys cernua Kuntze. 1891.

Common in sphagnum bogs. Specimens examined from Oneida, Madison, Onondaga and Oswego counties.

* **Ibidium ochroleucum** (Rydb.)

Gyrostachys ochroleuca Rydb. Britton, Manual 300. 1901.

This species is reduced to a variety of *cernuum* by Oakes Ames (Orch. 145. 1905); central New York specimens, though very rare, are quite distinct from *cernuum*.

ONONDAGA CO.: near Jamesville, *House*, 1903 (H).

Ibidium gracilis (Bigel.)

Neottia gracilis Bigel. Fl. Bost. ed. 2, 322. 1824.
Gyrostachys gracilis Kuntze. 1891.

This is the *Spiranthes gracilis* of Gray's Manual, but probably not of Beck, which seems referable to *S. Beckii* Lindl., although, according to the citations given, Mr. Ames apparently does not hold this view.

Common in sandy places, especially in Oneida County.

Ibidium vernalis (Engelm. & Gray)

Spiranthes vernalis Engelm. & Gray, Bost. Journ. Nat. Hist. **5**: 236. 1845.

Ophrys aestivalis Michx. Not Poir.
Neottia tortilis Muhl.; Barton; Elliott.
S. graminea praecox B.S.P. 1888.
S. praecox Wats. 1890.
S. neglecta Ames. 1904.
"*Gyrostachys praecox* Kuntze;" Britt. & Brown, Illus. Flora 1: 471. 1896. In part.
Gyrostachys vernalis (Engelm.) Kuntze, 1891; Small, 1903.

Mr. Ames gives the range of this species as Massachusetts to Florida, Kansas, Texas and New Mexico. Collected near Oneida, Madison County, *House*, 1902 (Y). (The *Gyrostachys praecox* of my previous list.)

CYTHEREA Salisb. Trans. Hort. Soc. 1: 301. 1812
Calypso Salisb. Parad. Lond. *pl. 89*. 1806. Not Thouars, Hist. Veg. Afr. Austr. 1: 33. *pl. 6*. 1805.

Cytherea bulbosa (L.)

Cypripedium bulbosum L. Sp. Pl. 951. 1753.
Calypso borealis Salisb. Parad. Lond. *pl. 89*. 1806.
Cytherea borealis Salisb. Trans. Hort. Soc. 1: 301. 1812.
Calypso bulbosa Oakes, Cat. Vermont Pl. 28. 1842.

In proposing a new name (*Cytherea*) for this generic type, Salisbury makes no reference whatever to his previous publication, but it is to be supposed that he did not propose a new name without knowing that his former name was faulty in some respect.

Known in central New York only from "Jordanville, Herkimer Co.," *J. V. Haberer* (N); near Rome, Oneida Co., *Bingham* (S.); and Tamarack Swamp, near Syracuse, Onondaga Co., *House*, 1905, *no. 1109* (H).

The previous list of the *Orchidaceae* of Central New York contained 45 species and 2 varieties. The additions made by the present article bring the number up to a total of 52 species and 2 varieties, besides one species regarding which there can be some doubt as to the authentic crediting to the central New York flora.

UNITED STATES NATIONAL MUSEUM.

The two eastern species of Melica

CHARLES VANCOUVER PIPER

In the United States, east of the Great Plains region, are two species of *Melica* which have long been known as *M. mutica* Walt. and *M. diffusa* Pursh. Their characteristic differences have been well indicated by Scribner, Proc. Acad. Phila. 1885, pp. 40–41.

Empty glumes very unequal and decidedly shorter than the 3- to 5-flowered spikelets; panicle diffusely branched, many-flowered.
M. diffusa.

Empty glumes subequal, nearly as long as the 2-flowered spikelets; panicle few-flowered, sparingly branched below, often reduced to a single raceme.
M. mutica.

These two species, as above distinguished, though very closely allied, have generally been recognized, and no question is here raised as to their validity. A consideration of evidence afforded by the literature pertinent to the problem indicates very clearly, however, that the name *diffusa* does not belong to the plant with which it has so long been associated.

The first binomial description relating to either of our species appears in the first edition of the Species Plantarum as follows:

MELICA.

altissima. 3. MELICA petalis imberbibus, panicula ramosissima. *Hort. ups. 20.* Melica flosculis glabris; summo urceolari. *Gmel. sib. 1. p. 98. t. 20.* Gramen avenaceum, locustis rarioribus muticis, virginianum majus. *Moris. hist. 3. p. 216. s. 8. t. 7. f. 51.* *Habitat in* Sibiria, Canada. ♃.

Linnaeus here confuses two very distinct plants. The Siberian plant is the true *M. altissima*, while the Virginia plant of Morison is what we now know as *Melica mutica* Walt. The character "panicula ramosissima" may, with some play to the imagination, be applied to the narrow and dense panicle of the Siberian species, but it is wholly inapplicable to the American plant.

Walter, the next writer to touch on the eastern American Melicas, distinguished in his Flora Caroliniana, 1788, as he thought, two species, as follows:

40. MELICA. Cal. 2-valvis, 2-florus. Rudimentum floris inter flosculos.
altissima 1. petalis imberbibus, panicula ramosissima, floribus subacutis.
mutica 2. petalis imberbibus, panicula laxa pauciflora, floribus magnis muticis obtusis.

It will be noticed that Walter copies Linnaeus' description of *M. altissima*, adding two words "floribus subacutis." The types of these two plants of Walter are not now in his herbarium, according to Professor A. S. Hitchcock (Ann. Rep. Mo. Bot. Gard. 47. 1905).

These Walterian species were also unknown to Michaux, who in his Flora 1: 62. 1803, treats the genus as follows:

MELICA. L.

Gluma 2-valvis, 2-flora. *Cal.* 2-valvis. Inter flosculos rudimentum tertii floris pedunculati.

GLABRA. M. glabra, erecta, panicula erecta, laxa; ramulis simplicibus, pauciflоris: floribus nudis, majusculis.:

MORIS., *hist.* 3. sec. 8. t. 7. f. 51.

OBS. Forsan huc referendæ sunt *M. altissima* et *mutica*. WALT.

HAB. a Virginia ad Floridam.

There can be scarcely any doubt that Michaux's plant is what we now call *M. mutica*, but a spikelet in herb. Torrey, said to be from Michaux's type specimen, is *Koeleria cristata*.

Pursh, Fl. Am. Sept. 1: 77. 1814, distinguishes two species as follows:

90. MELICA. *Gen. pl. 113.*

1. M. panicula laxa pauciflora: ramulis simplicibus, floribus obtusis imberbibus, caule erecto glabro.—*Mich. fl. amer. 1. p. 62.* *glabra.*
   M. mutica. *Walt. fl. car. 78.*
   Icon. *Moris. hist. 3. s. 8. t. 7. f. 51.*
   In shady places. Virginia to Florida. ♃ July. *v. s.*
2. M. panicula diffusa ramosissima, floribus acutis imberbibus, caule erecto pubescente. *diffusa.*
   M. altissima. *Walt. fl. car. 78.*
   In sandy swamps: Virginia and Carolina. ♃ June. *v. s.*

It will be noticed that for the description of *diffusa*, Pursh copies Walter's description of *altissima*, adding the word "diffusa" in describing the panicle, and the phrase "caule erecto pubescente" at the end. An important point, too, lies in the statement that *diffusa* occurs in "Virginia and Carolina," in neither of which states does the plant now referred to *M. diffusa* occur.

Pursh, as is well known, had access to Walter's herbarium, so presumably the abbreviation "v. s." means that he saw Walter's types, not merely that he saw dried specimens, as in all probability he had seen living specimens of one or both, and we would therefore expect the frequently used abbreviation "v. v." if he were referring to his own collections. In any case, Pursh's testimony as to the identity of Walter's species is the only presumably direct evidence we have as to what they really are.

Elliott, Sketch Bot. S. C. and Ga. 154. 1821, recognizes *M. glabra* Michx. and quotes *M. mutica* Walt. as a synonym. He further adds:

"I have from Columbia a variety with the leaves pubescent, the flower evidently smaller, the valves more acute, less membranous at the summit, and handsomely spotted with purple. It is probably the *M. altissima* Walt. but it has scarcely character enough for a distinct species."

Muhlenberg in 1817, Gram. Descr., in treating the eastern Melicas, distinguishes two species — naming both as new — as follows:

XXII. MELICA.

Cal. 2-valvis 2-florus. Rudimentum floris inter flosculos.

1. MELICA SPECIOSA.

Culmo tripedali — quadripedali erecto, nodis glabris.
Foliis lineari-lanceolatis nervosis, subtus pubescentibus.
Ligula bifida.
Vagina nervosa subpubescente.
Panicula secunda.
Ramis paniculae solitariis patulis trifloris, flosculis pedicellatis, pedicello pubescente.
Cal. 2-valvis, valvulis ovato-lanceolatis striatis *obtusis* 2-floris cum rudimento tertii.
Cor. 2-valvis nervosa imberbis, valvula interiore margine pubescente, exteriore glabra.
Stam 3.
Pist. 2, plumosa.
Semen.
Radix ♃.
Habitat in montibus Pennsylvaniae, floret Junio.
Specimen e Virginia culmo inferne purpureo, habet.
Cal. 2-valvis corollae aequalis, valvulis ovatis *acutis* 5-nerviis 2-floris.
Cor. 2-valvis exterior ovata acuta multinervia, interior obtusa margine pubescens.
Neuter flos 2-valvis obtusus, hermaphroditis brevior.

2. MELICA RACEMOSA.

Culmo erecto glabro nodoso basi amethystino, foliato.
Foliis linearibus nervosis scabris.
Ligula abbreviata pilifera subbifida.
Vagina scabra.
Panicula simplici contracta s. racemo 6-flor. terminali, flosculis nutantibus, rachi angulata.
Ramis s. pedunculis *unifloris* solitariis brevibus.
Cal. gluma 2-valvis, valvula una *obtusa*, altera acuta glabra, corolla longior, 2-flora et rudimento tertii.
Cor. gluma 2-valvis, exteriore nervosa majore acuta glabra, altera margine pubescente obtusa.
Stam. 3, alba.
Pist. 2, alba.
Semen ovale flavescens nitidum.
Radix ♃.
Habitat in Carolina, Georgia, nobiscum floret medio Maio.
Habitus *Melicae nutantis*, sed distincta species.

It is interesting to note here that one of Muhlenberg's species has the sheaths pubescent, the other merely scabrous. We have

therefore the idea expressed consecutively by Pursh, Elliott and Muhlenberg that the two supposed species are distinguished by a character of pubescence. There is nothing to indicate such a distinction in Walter's descriptions. Michaux's name *glabra* may naturally have suggested prominence to an opposed character. Finally, Pursh may have imbibed his ideas of two species through Muhlenberg, with whom he was intimate, or he may actually have gotten the fact from Walter's types, and Muhlenberg may simply have followed Pursh.

So far as the material in the National Herbarium goes, the plant so long called *M. diffusa* never has pubescent sheaths or leaves, and it seems never to have been found in Virginia or Carolina. The conclusion, therefore, seems unavoidable that the name *diffusa* really belongs to the form of *mutica* with pubescent sheaths; also that it is probably the same as *M. altissima* Walt., as Pursh indicates.

The character of "panicula ramosissima" appears to be clearly a heritage from Linnaeus' original description, rather than a statement of fact. Walter's contrasting characters of "floribis subacutis" and "floribus muticis" are ignored by Pursh, and so far as Atlantic coast specimens are concerned seem to have no real basis.

The synonymy of the eastern Melicas then seems to be as follows:

MELICA MUTICA Walt. Fl. Car. 78. 1788

M. glabra Michx. Fl. Bor.-Am. **1**: 62. 1803.

M. rariflora Schreb. Beschrieb. Gr. **2**: 157. 1810. (This is merely a new name proposed, considered preferable to either *mutica* or *glabra*.)

M. racemosa Muhl. Gram. 88. 1817.

M. Muhlenbergiana Schultes Mant. **2**: 294. 1824. (New name for the above, owing to the older *M. racemosa* Thunb.)

M. mutica glabra A. Gray, Man. Ed. 5, 626. 1867.

MELICA MUTICA DIFFUSA A. Gray, Man. ed. 5, 626. 1867.

M. diffusa Pursh Fl. Am. Sept. **1**: 77. 1814.

M. speciosa Muhl. Gram. 87. 1817.

? *M. altissima* Walt. Fl. Car. 78. 1788.

For the more western plants heretofore considered to be *M. diffusa* Pursh, the only available name is

MELICA NITENS Nutt. in herb.

M. diffusa nitens Scribn. Proc. Acad. Nat. Sci. Phila. 1885: 44. 1885.

M. scabra Nutt. Trans. Am. Phil. Soc. **5**: 148. 1837. Not Kunth, 1822.

The types of both these are in the herbarium of the Philadelphia Academy of Sciences. I do not see that *nitens* can be maintained as distinct from the ordinary form of what has been called *M. diffusa*.

BUREAU OF PLANT INDUSTRY,
UNITED STATES DEPARTMENT OF AGRICULTURE.

Crataegus in Berks County, Pennsylvania — III

CALVIN LUTHER GRUBER

This paper on *Crataegus* is designed to include the known species of *Crataegus* of the *punctata* group as found in Berks County, Pa. The following characteristics of the group are either constant or so general that only exceptions will be noted in the descriptions:

Flowers very fragrant, in compound villous-pubescent or tomentose cymes; petals at length reflexed, margins frequently revolute; sepals linear or linear-subulate, entire or sparingly minutely toothed; stamens normally 20; bractlets mostly falling when flowers open, pale-yellow or pinkish; flowering about the third week in May: leaves some form of obovate or spatulate, villous-pubescent or tomentose when young, especially on ribs below; mature leaves more or less villous-pubescent, sometimes glabrate above, villous or tomentose on ribs below; blade entire at base, then serrate or crenate-serrate, and usually doubly serrate or cut-serrate above middle or near apex; glands, when present, small, sessile, drop-like, and whitish or colorless; petiole with shallow, usually wide groove above, taper-margined, frequently reddish or purplish below, the color sometimes extending along midrib for half the length of the blade; ribs impressed above, prominent below: young twigs villous-pubescent or tomentose; lenticels whitish; mature twigs grayish-russet, grayish-green, or brownish-russet: thorns slender to medium, occasionally found tipping a branchlet; trunk and bases of large branches usually beset with several to many long-pronged compound thorns 6–15 cm. long: bark light gray or pale ash-gray toward ends of branches: fruit usually spreading or drooping, 1–several on a cluster, frequently solitary, usually slightly pubescent and concave at base and apex, dark red or light maroon when beginning to color in August, falling mostly after the leaves; sepals usually reflexed or spreading, sometimes broken away, usually on a short neck; cavity deep, 3–4 mm. wide, cupshaped or cylindrical; pedicels moderately to slightly pubescent, 5–20 mm. long; seeds commonly roughish and with 1–3 usually shallow, wide grooves on back; flesh firm, acid or bitterish-acid: branches long, mainly horizontal; usually with a wide, flattened crown.

CRATAEGUS PUNCTATA Jacq.

A few trees of this species are found near Kutztown, Pa. Flowers 16–21 mm. wide, styles 3–5, anthers dark purplish-red

or claret; leaves obovate to lance-obovate, frequently cut-serrate near apex; fruit red-maroon, globose, 11–15 mm. long and thick.

CRATAEGUS CROCATA Ashe Ann. Carnegie Museum 1: 389. 1902

Similar to *C. punctata* and found growing with it; but the anthers frequently are whitish on the sides and the fruit is depresed-globose and pale yellow.

Crataegus punctata mutabilis var. nov.

Flowers 16–21 mm. wide, cymes 3–15-flowered, stamens 18–20, anthers dark purplish-red, styles 3–5: mature leaves sparingly villous-pubescent to glabrate on surface; petiole 1–2.5 cm. long; blade 3–6.5 cm. long, 2–3.5 cm. wide, obovate, lance-obovate, or spatulate, cuneate or narrowly cuneate at base, acute, obtuse, or rounded at apex, entire at base, sometimes nearly to middle, sometimes with a few short lobes near apex, especially on leading shoots, turning pale yellow, mottled with russet, in autumn, and falling mostly about the middle of October: mature twigs villous or glabrate along middle; bark on trunk gray to dark-gray: thorns rather few on branches, 2–4.5 or sometimes 6 or 7 cm. long: fruit red-bronze on one cheek and light to scarlet-bronze on the other or entirely some shade of light bronze, oblong-globose to globose, 13–16 mm. long, 12–15 mm. thick; flesh yellowish; seeds 3–4, 7–8 mm. long, back sometimes without grooves; fruit ripe about the first or second week in October and falling with and after the leaves during the latter half of October and the beginning of November: a small tree attaining a height of 6 m. and a trunk-circumference of 8 dm.

Type two and one-half miles northwest of Kutztown, Pa., in wet ground, near left bank of Sacony Creek.

Crataegus Cydonia sp. nov.

Flowers 19–23 mm. wide, cymes 5–15-flowered, stamens 18–20; anthers rose, becoming purplish-rose; styles 2–5, commonly 3: mature leaves varying from dark-green to yellowish-green on the same tree; petiole 1–1.75 cm. long; blade 3–5 cm. long, 1.75–3.25 cm. wide, at ends of leading shoots sometimes 6–6.5 cm. long and 4–4.5 cm. wide, obovate or oval-obovate, base cuneate, apex usually acute, each rib usually ending in a very short, acute lobe tipped by a narrow tooth, the lobes mostly on the apical third; leaves turning dull-, russet-, or yellowish-bronze or yellow and falling late in October: mature twigs glabrate or sparingly pubescent; bark on trunk dark ash-gray to black-gray: thorns rather abundant, 3–5 or 6.5 cm. long, compound thorns often far out on old branches: fruit solitary or in loose, often

long-branched clusters, rich quince-yellow to light-yellow, frequently one side shaded with red-orange, occasionally rich, dark olive-green at apex, punctate with green- or brown-russet, cylindrical-globose or subglobose, 13–20 mm. long and thick; surface usually uneven and apex angular; cavity often elliptical; rarely a few stamens are fleshy and pale-yellow; apex of pedicel frequently surrounded by a fleshy ring; flesh rich yellow, becoming rather soft; seeds 3–4, 7–8 mm. long; fruit ripe about the first or second week in October and falling with and after the leaves late in October: a small tree attaining a height of 6 m. and a trunk-circumference of 6 dm.; old branches usually crowded with short branchlets.

Type about two and one-half miles west of Kutztown, Pa., in a low field.

Crataegus Moselemensis sp. nov.

Flowers 18–22 mm. wide, in 3–15-flowered cymes; stamens 16–20, often as long as the petals; anthers pink, appearing yellow in pollen; styles 2–4, mostly 3: mature leaves dark-green above; petiole .5–1.5 or 2 cm. long; blade 3–5 cm. long, 2–3.5 cm. wide, or on ends of leading shoots often 5–7 cm. long and 4–5 cm. wide, obovate to oval-obovate; base cuneate to acute; apex usually rounded to a short acute point, sometimes broadly rounded; a prominent broader tooth at end of each rib in upper part of blade, often having the appearance of 4–6 pairs of very short lobes, especially on leading shoots: mature twigs often glabrate at middle; bark on trunk gray to dark-gray, somewhat shaggy: thorns few, 1–4 cm. long: fruit rich dark-crimson or light-maroon, punctate with orange or yellow, cylindrical-globose, 16–20 mm. long and thick; sepals subsessile; flesh whitish or yellowish, often reddish-orange at surface; seeds 2–4, 7–9 mm. long, nearly smooth; fruit ripe about the fourth week in September.

Type about one-half mile west of Moselem, Pa., on William Hieter's farm, on high ground, near a large spring; a large, broad-headed tree, 7 m. high, 13.7 m. spread, with a trunk-circumference of 2 m. near ground, 1.83 m. near middle, and 3.25 m. at top of trunk; about 90 years old (1902). This hawthorn was brought to my notice by Mr. Samuel S. Gruber, who also aided me in securing material.

Crataegus Moselemensis corrugata var. nov.

Cymes 5–25-flowered; stamens 18–20, anthers dark-pink; styles 2–5, usually 3: mature leaves rather more villous-pubescent and slightly narrower, obovate to oblong-spatulate, each of the 2–5 pairs of very short lobes crenate and usually with an acute tooth at apex: mature twigs glabrate or sparingly pubescent at

base and in the axils of the leaves; bark on trunk ash-gray: thorns rather few, on twigs often yellowish-tipped, 1.5–3 cm. long: fruit scarlet or red, depressed-globose, 12–14 mm. long, 13–15 mm. thick; flesh yellow; seeds 6–7 mm. long; fruit ripe about the second week in October and falling slightly with and after the leaves during the latter half of October: a small tree, attaining a height of 6 m. and a trunk-circumference of 6.5 dm.

Type in North Heidelberg Township, Pa., near Charming Forge, in meadow, on right bank of Tulpehocken Creek.

Crataegus Triosteum sp. nov.

Flowers 19–25 mm. wide, cymes 5–20-flowered, the branches of the cyme sometimes racemose; stamens 19–21; anthers pink or rose, often fading lavender-rose; styles 2–5, often 2, long and slender; sepals usually becoming elongated after petals fall: mature leaves often glabrate but usually tomentose on ribs beneath, somewhat shining, dark-green or dark yellowish-green above, light-green below, rather firm; petiole sometimes tinged with pale brownish-olive at base, 1–2.5 cm. long; blade 5–7.5 cm. long, 2–4, or on ends of leading shoots, 5 cm. wide, broadly oblanceolate, spatulate, narrowly obovate, or on leading shoots obovate; base cuneate, on leading shoots often abruptly so; apex abruptly acute or subacuminate, sometimes obtuse; usually a prominent tooth at end of each rib, frequently with 4–5 pairs of very short lobes above middle, the lobes often rather conspicuous on vigorous shoots; leaves falling about the middle or latter half of October, those on fruiting branchlets early in October; glands often clustered on stipules: young twigs sparingly to moderately loosely pilose; mature twigs glabrate or slightly pubescent at base; bark on trunk dark ash-gray, scales weak: thorns moderately numerous, 3–7 cm. long, usually slightly reflexed and curved: fruit in loose, long-branched clusters, globose to oblong-globose, 13–16 mm. long and thick; when fully ripe, orange-cardinal or cardinal, apex sometimes rich dark-green, usually much punctate with russet, generally rounded; sepals usually prominent and long, spreading-recurved to ascending, often waving, remaining green for a long time; flesh yellow; seeds 3–5, 8–9 mm. long, placed subcentrally; fruit ripe about the first or second week in October and falling with and after the leaves; trees in dry soil usually have redder and smaller fruit with less conspicuous sepals: a sturdy, small tree, trunk often well defined nearly to the top, with numerous ascending branches or the upper ones horizontal, attaining a a height of 3–6 m. and a trunk-circumference of 4–6 dm.

On banks of streams and also on high gravelly soil.

Type on left bank of Moselem Creek, near Moselem, Pa.

KUTZTOWN, PENNSYLVANIA.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1904)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omission their kindness will be appreciated.

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Autran, E. Note sur le Caá-éhé. Revista Farmac. **44**: 70–74, 105–111. 1904.

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Probably native of Paraguay.

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